THE

NATURAL HISTORY

OF

PLANTS.

VOL. I.

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NATURAL HISTORY

OF

PLANTS.

BY

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VOL. I.

RANUNCULACEÆ, DILLENIACEÆ, MAGNOLIACEÆ, ANONACEÆ,
MONIMIACEÆ, ROSACEÆ.

LONDON:
L. REEVE & CO., 5, HENRIETTA STREET, COVENT GARDEN.
1871.

LONDON:
SAVILL, EDWARDS AND CO., PRINTERS, CHANDOS STREET,
COVENT GARDEN.

TO THE MEMORY

OF

J. B. PAYER,

MEMBER OF THE INSTITUTE (ACADÉMIE DES SCIENCES),

PROFESSOR OF BOTANY IN THE FACULTY OF SCIENCE OF PARIS AND THE

UPPER NORMAL SCHOOL

(1818–1860).

INTRODUCTION.

"Il n'y a qu'une manière d'avancer les sciences, c'est de les simplifier ou d'y ajouter quelque chose de nouveau."—POINSOT.

"We must not, like children, receive the opinions of our fathers, only because our fathers held them."—MARCUS AURELIUS.

FOR the first idea of this book we are indebted to the much-regretted philosopher, to whose memory it is dedicated. In the Introduction to his *Traité d'Organogénie Comparée de la Fleur*, Payer says: "In a kind of illustrated *Genera Plantarum*, undertaken about ten years ago, and which I hope will be published before long, I shall show, by numerous applications, the great importance of organogenic studies in demonstrating the true affinities of plants to each other." For this purpose he had prepared a large number of cuts, which he left to us. Of the text of the work and the plan the Author proposed to follow, we unfortunately know nothing. All that we have to guide us is the essay published under the modest title of *Leçons sur les Familles Naturelles des Plantes*, a work interrupted in 1860 by his premature decease, and continued by us till the present time. It is, however, probable that the very rich organogenic lore of the author would have entered very largely into the composition of the book.

That Payer himself should not have been able to execute his stupendous project is no doubt a cruel injury to science. But from the severe lessons of death we learn at least this much, that to raise such a monument to science it is important to begin its execution early. He who does not shrink from such an enterprise may from the commencement hope, either that he himself will be able to crown his work, or that, if few be the days allotted to him, he will leave a firm foundation upon which those who succeed him may build. In this case the plan will be traced out, and those who continue the work will be able to conform to it, the key

at least having been laid before them. This is the chief consideration which has led us to begin thus early the publication of this *Natural History of Plants*. It needed no doubt a fuller maturity; and the task is one that a botanist well inured to all the difficulties of the science would be fit to accomplish only at the end of a long career. Accordingly, to remedy our incompetence, the existence of which we have never concealed from ourselves, we have tried during eight years of assiduous labour to become familiar with the numerous works published on the different parts of the Vegetable Kingdom; we have analyzed most of the genera of plants found in the large collections of Europe, prepared numerous drawings, and have quintupled the number of cuts left by Payer. Only when materials have been wanting for the direct observation of the types have we confined ourselves to reproducing the characters given by other authors, leaving them all the merit and all the responsibility. But whenever facts are given without indicating any source from which they are drawn, we have made out from nature what we have described. Before beginning this exposition we must explain the general plan followed in the work.

The orders of plants are described successively, each being nearly always divided into a certain number of series, which often, though, as will be seen, not invariably, correspond with what most authors call tribes. Each series begins by the detailed study of a leading type, whose characters are described and figured as completely as possible, but only with reference to the more important features. This description, precise, though summarized, and sufficient, despite its very elementary form, for the beginner or the reader who does not care to go deeper into the subject or to verify all its details, is printed in large type in the text. The more special details, the characters of secondary importance, the historical and bibliographical references which enable the professional botanist to check our observations and start afresh on further inquiries from the point at which we stop,—all these are found in small text in notes at the bottom of each page, which, of course, no one is obliged to read.

After describing the genera in series, we give a summary of the history of the order, its affinities and geographical distribution;

and discuss its value with that of the characters on which are based the series into which the whole group is divided. Finally, the properties of the useful plants it contains are enumerated. After the text comes a *Genera*, in which, omitting the characters common to the whole series and defined in the first type described, only the important points which mark off each genus sharply from its neighbours are given. These generic descriptions will of course be more detailed in those very natural orders which were formerly considered as great single genera, or as collections of a few very large genera. In such cases it will be unnecessary to lay any stress on minute shades of distinction in the text; we shall thus avoid useless repetitions in certain groups made up of nearly similar elements, such as *Leguminosæ*, *Cruciferæ*, *Compositæ*, *Gramineæ*, and the like.

As with the text so with the figures. The genera whose organization is either most important or least known, and especially those which head our series, will have most of their parts figured: habit, inflorescence, flower (entire and in longitudinal section), sexual organs, floral diagram, fruit, seed (entire and in section), &c. But of the genera derived from these only the chief differentiating characters will be figured, while there will be no need to draw those of their organs which are similar to the same organs in the typical genus.

The reasons for the succession in which the different families will be described it appears illogical to consider here, or to discuss the classification of objects before we have studied them, and while their exact characters are supposed to be still unknown. As, with each order, until we have analyzed and described its genera and compared them with one another, we are unable to decide on the value of the characters which allow us to arrange them in series; so, only after scrutinizing the organization of the whole of the Vegetable Kingdom, shall we be in a position reasonably to inquire into the principles which may govern its classification. What profit, indeed, can result from discussing the value of facts and characters that we have as yet not investigated?

Suffice it, then, at the commencement of this work, to say merely that in the first instance we shall follow the generally received

practice of dividing the Vegetable Kingdom into three great *branches* (*embranchements*), founded on the presence or absence, and the number of cotyledons, and shall successively examine DICOTYLEDONS, MONOCOTYLEDONS, and ACOTYLEDONS. Seeing that we begin the study of DICOTYLEDONS with the orders called *Polycarpicæ—i.e.*, those in which the carpels of the flower, and later on of the fruit, are free from each other, and recall as nearly as possible by their arrangement on the floral axis that of the leaves on the stem—the reader will at once perceive the importance we assign to the female reproductive organ in classification. But as even from the very beginning he will here and there find types which are exceptional in that their carpels are united to a variable extent, while most authors have still put them in the same natural group, he will also understand that we cannot admit either "absolute characters" or "immutable subordination," the foundations of what is at present called the natural system. We have said enough to indicate what principles we shall follow in the classification of the Vegetable Kingdom.

BOTANIC GARDENS OF THE SOCIETY OF MEDICINE OF PARIS,
FEBRUARY, 1869.

TO THE ENGLISH READER.

I WISH to take this opportunity of expressing my thanks to the authorities of the Linnæan Society and of the Cambridge University Library for their courtesy to me; also to my brother, Mr. Numa Edward Hartog, for his kind assistance in the wearisome task of revising the proofs, which has materially increased whatever value this translation may possess.

M. M. H.

TRINITY COLLEGE, CAMBRIDGE,
MARCH, 1871.

FIRST BRANCH OF THE VEGETABLE KINGDOM.

DICOTYLEDONS

(*Exogenæ* DC.—*Anthophytæ* OK.—*Carpophytæ* OK.—*Exorhizeæ* L. C. RICH.—*Synorhizeæ* L. C. RICH.—*Phylloblastæ* REICHB.—*Acramphibrya* ENDL.—*Synechophyta* SCHLEID.).

Plants whose embryo has, with some rare exceptions, two cotyledons, and whose stem generally consists of a distinct bark and wood of concentric zones surrounding a central pith.

NATURAL HISTORY OF PLANTS.

I. RANUNCULACEÆ.

I. COLUMBINE SERIES—REGULAR FORM.

WE shall commence the study of this group by the analysis of the common Columbine (*Aquilegia*[1] *vulgaris* L.), a herb found growing pretty frequently in certain hilly woods, under hedges, and on the borders of forests, in marshy fields, and also cultivated in all gardens, where it flowers in the spring and part of the summer (fig. 1).

FIG. 1.
Aquilegia vulgaris.

Its flowers are of the kind termed *hermaphrodite*, that is, containing both male and female reproductive organs. They are *regular*, bearing around their axis or floral receptacle, a certain number of appendages, arranged with great regularity from below upwards, as will be seen at a glance on examining the theoretical *diagram* of the flower—*i.e.*, its plan, or the projection of all its component organs on a horizontal plane (fig. 2).

[1] *Aquilegia* TOURN., *Instit.*, 428; *Coroll.*, 30, t. 242.—L., *Gen.*, n. 684.—JUSS., *Gen.*, 234.—DC., *Prodr.*, i. 50.—SPACH, *Suit. à Buff.*, vii. 329.—ENDL., *Gen.*, n. 4795.—PAYER, *Organogénie*, 245, t. liv.—B. H., *Gen.*, 8, n. 23.—H. BN., *Adansonia*, iv. 43.

We first notice the outer envelope, a circle, or whorl of five leaves, which form the *calyx*; these are the *sepals* (*s*). Two of them are in front by the bract (*b*), which is below the flower; two others are lateral, and the fifth behind. They overlap in the bud in a quincuncial arrangement or *æstivation*; the posterior sepal (No. 2) overlapping its two neighbours, the lateral sepals (Nos. 4, 5) which are each overlapped on both sides, and of the anterior sepals one is quite uncovered (No. 1,) while the other No. (3) is overlapped on one side and overlaps on the other. Next, forming the second envelope, or *corolla*, come five other leaves alternate with the sepals—*i.e.*, corresponding with the intervals between them. These leaves or *petals* (*p*) overlap in the bud so as to be imbricated, as shown in the diagram. They have no adhesion whatever with one another, and fall separately.

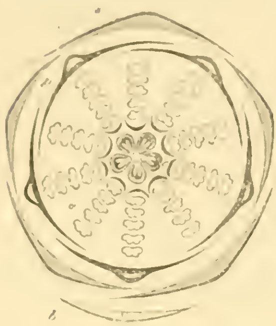


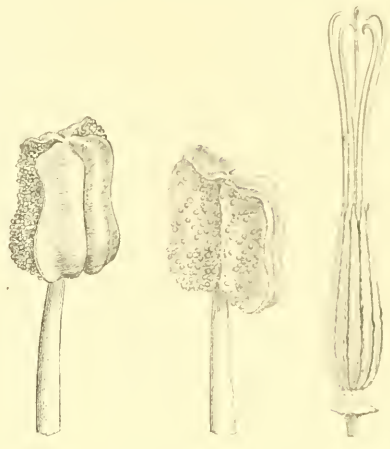
FIG. 2.
Aquilegia vulgaris. Diagram.

Within and above the corolla is the *androceum*, composed of a large number of *stamens*, or male fecundating organs. If we suppose that, as is often the case, and as is represented in the diagram, these are fifty in number, we shall easily perceive that there are first five opposite the sepals, forming the first whorl or *verticil*. Within, and a little above these, come five others opposite the petals. Next comes a third whorl of stamens opposite the first; then a fourth alternate with these, and so on, so that we may count ten whorls of stamens, arranged in ten radiating rows, of which five answer to the sepals and five to the petals.

Each of these stamens, perfectly independent of the others, is formed of a filament, flattened and dilated below, tapering to a point above, where it supports the base of an oval flattened *anther*, with two lateral cells containing the *pollen*, or fertilizing dust. Each cell opens, after the expansion of the flower, by a longitudinal cleft near the margin, but often a little nearer the outer than the inner face, so that the anther is slightly *extrorse* (figs. 3, 4)[1]. These fifty

[1] After the anthers have opened, the cells open out (as seen in fig. 4) so as to become plane, and are placed edgewise; they then touch along the whole of their outer surfaces, while the inner surfaces, covered with grains of pollen, which soon fall, look laterally and outwards. The pollen-grains are elongated, with three equidistant longitudinal grooves. The anthers of the superior stamens are the first to dehisce, shed their pollen, and then turn black.

stamens are fertile; but within and above them are ten others which are sterile and reduced to flattened scales, of which five are opposite to the sepals, and five to the petals. These *staminodes* are inserted immediately below the *gynæceum* or *pistil*. This is composed of five[1] *carpels* (*c*), which are opposite the petals, as shown in the diagram[2] (fig. 2). The whole of the lower portion of each carpel is hollow, and the cavity contains a large number of little whitish bodies —the *ovules* or future seeds of the plant. The carpels do not cohere at all, and as they are also placed above all the other floral organs we have studied, we describe them as *free* and *superior*.



Aquilegia vulgaris.

FIG. 3. Stamen dehiscing. FIG. 4. Stamen completely opened. FIG. 5. Gynæceum & staminodes.

As yet we have only considered the number of appendages thus stationed in ranks on the floral receptacle of the Columbine, and the relative positions of the various organs one to another. But we have, and not without good reason, hardly taken into account either form, size, or colour; for external circumstances, such as the aspect of the ground, the chemical composition and moisture of the soil, the use of manure, the style of cultivation, and many other causes often unperceived, may bring about indefinite variations in these characters, which are of quite secondary importance.

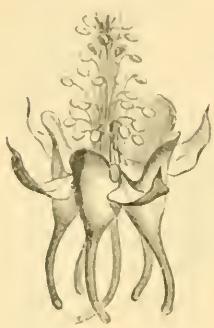
Thus the sepals are sometimes greenish, but far more often coloured. The petals assume at times the form of small, expanded, flattened blades, like the sepals; but they often have near the base a decurrent spur, lined towards its apex with a glandular tissue which secretes a sweet juice or nectar. The petal has then the general appearance of a cornet.[3] The stamen generally possesses, as

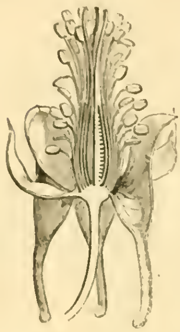
[1] The normal number; but in cultivated plants we often find more numerous carpels, sometimes arranged in a single whorl, sometimes in an inner and an outer division. *A. pyrenaica* DC. has sometimes ten carpels, five outside and five inside exactly alternate with these.

[2] RŒPER considers that the position of the carpels depends on the number of staminal verticils, so that if these be odd, the carpels are opposite the petal; if even, opposite the sepals.

[3] There are, among others, *spurred* Columbines and *starred* Columbines, and in these last the petals are flattened, coloured leaves. As the metamorphosed stamens may equally present these modifications, we may have double spurred or double starred Columbines. TOURNE-

stated above, an oval flattened anther, whose cells are attached to the two sides of a vertical linear *connective;* but this connective is sometimes laterally expanded into a hooked spur, resembling the spurs of the petals : and still more frequently each anther assumes the appearance of a small green leaf, or coloured petal. In many flowers, too, the stamens are metamorphosed into spurred petals fitting one within another. The carpels are equally susceptible of all these modifications.





Aquilegia vulgaris.

FIG. 6. Flower.

FIG. 7. Longitudinal section of flower.

These carpels are normally closed (fig. 5).[1] Each consists of an elongated unilocular *ovary,* surmounted by a narrow *style,* bearing along the whole length of the inner angle a longitudinal groove. At the slightly dilated summit of the style, the thickened edges of this groove are covered with a large number of projecting *stigmatic* papillæ. On opening the back of the ovary, we find in the inner angle of the cavity a double projecting cord, or *placenta,* which supports on each half a vertical row of nearly horizontal ovules, those of one row touching those of the other by their inner borders. Here each ovule has a projecting ridge, or *raphe.* The *micropyle* or hole, through which it is impregnated is placed near

Aquilegia vulgaris.

FIG. 9. Transverse section of ovary.

FIG. 10. Fruit.

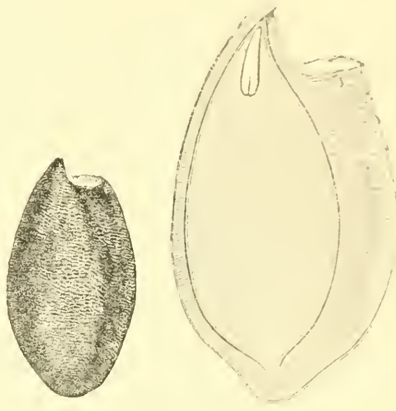
FORT (*Instit.*, 428) has enumerated as so many species all these varieties, due almost constantly to the influence of cultivation, and which, besides, may be seen in flowers of every tint—pink, white, or bluish. He further describes Columbines that are variegated, punctated, with pendulous flowers, with erect flowers. DE CANDOLLE has studied the structure of many of these monstrous forms (*Mém. de la Soc. d'Arcueil,* iii. 393–396). Many other anomalies have been noted, among others by CLOS (*Bull. Soc. Bot.*, iv. 160), A. TASSI (*Ibid.* viii. 394), and by ourselves (*Adansonia*, iv. 17–18), &c.

[1] It may happen accidentally, especially in gardens, that the carpels remain open, and spread out like leaves. We then usually see bodies on each margin that represent ovules, sometimes normal, sometimes transformed into tongues, or leaflets, of very variable size and form (fig. 8). This anomaly has often been pointed out in Aconite, Larkspur, and many other genera, especially in those which have multiovulate carpels.

FIG. 8

the placenta, so that it is lateral, exterior to the raphe. These ovules are therefore *anatropous.*

After flowering, all the parts of the flower fall off, except the carpels, which become as many *follicles* (fig. 10), or dry fruits with numerous seeds, opening longitudinally along the inner angle. The anatropous seed has on one side a marked projecting raphe, which ends in a whitish mark, or *hilum,* by which it is attached, and which looks as if it were torn. Near it is the micropyle, which appears like a minute depression. This seed has a triple integument, composed of a superficial cellular envelope, or *epidermis,* a thick, dry, brittle *testa* of very dark colour; and within a thin, white membrane, surrounding the copious fleshy albumen, which contains near its apex a very small embryo, with an acute base and obtuse cotyledons.



Aquilegia vulgaris.

Fig. 11. Seed. Fig. 12. Longitudinal section of seed.

The Columbines are perennials, found in the north temperate zone, in both the Old and New Worlds. The species, which have been much multiplied, may be reduced to one or two for France and Europe.[1] Several are found in Asia[2] and North America.[3] The stem, which is at first simple, springs from a taproot, and bears alternate ternately compound leaves, with petioles dilated at the base, the lower leaves much simplified, or often reduced to scales. The stem ends in a flower, below which are bracts from the axil of each of which may spring another axis also ending in a flower, and so on. After flowering, the upper part of the stem falls off, while the base enlarges (chiefly in the medullary region) to form a reservoir for the accumulation of nutritive juices destined to supply the hitherto dormant axillary buds of the reduced leaves. These buds enlarge the faster as they

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[1] Gren. & Godr., *Fl. Fr.*, i. 44. — Reichb., *Icon.*, iv. t. 114–119.—Walp., *Rep.*, i. 50; v. 6; *Ann.*, i. 13; ii. 12; iv. 25.

[2] Hook. & Th., *Flor. Ind.*, i. 43; Sieb. & Zucc., *Flor. Jap. Fam.*, 76.—Boiss., *Diagn. Pl. Orient.*

[3] A. Gray, *Ill.*, t. 14.

are higher up on this basilar portion of the stem, each becoming in turn a leafy aërial branch ending in an inflorescence; later on, swelling at the base, and then giving up its juices to supply the evolution of the buds axillary to its first leaves. Thus the rhizome of the Columbine gradually ramifies, while the primitive root, after having at first formed a tolerably large tap-root, gradually becomes hollow and withers, till it has entirely disappeared, and the plant is wholly nourished by the adventitious roots, which appear at each period of vegetation at the base of the ascending axes. Many perennial *Ranunculaceæ* resemble this, and belong to the group of plants with definite axes evolved successively.

Xanthorhiza apiifolia LHÉR.,[1] though of very different habit, and with very small flowers which at first sight hardly recall those of the Columbine,[2] presents nearly the same floral organization, and may be considered a smaller type of this,[3] from which the only essential point of difference is the smaller number of staminal whorls in the former. The perianth (fig. 13) is formed of five caducous sepals, as a rule quincuncially imbricated in the bud, and of five smaller, fleshy, glandular petals, contracted at the base into a narrow claw, and dilated above into a cordate somewhat concave limb (fig. 14).

Xanthorhiza apiifolia.

FIG. 13. Flower.

FIG. 14. Petal.

The stamens are often ten in number, arranged in two whorls, so that five are opposite the sepals and five opposite the petals; but we often find the parts of one whorl more or less abortive. Each stamen consists of a hypogynous filament, and a basifixed flattened bilocular anther, dehiscing by two longitudinal lateral clefts, rather turned inwards than outwards. The gynæceum is often formed of five free carpels opposite the petals, each composed of a unilocular

[1] *Xanthorhiza* MARSH. *ex* SCHREB., *Gen.*, 727, n. 1851.—LAMK., *Ill.*, t. 854; DC., *Prodr.*, i. 65. —SPACH, *Suit. à Buff.*, vii. 407.—ENDL., *Gen.*, n. 4803.—A. GRAY, *Ill.*, t. 17.—B. H., *Gen.*, 9, n. 29.—H. BN. *Adansonia.*, iv. 44.—*Xanthorhiza apiifolia*, LHÉR., *Stirp. Nov.*, 79, t. 38.—DUHAM., *Arbr.*, last ed., iii. t. 37.

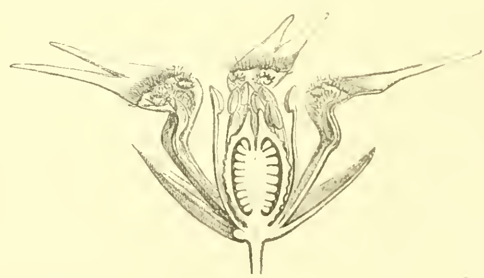
[2] This has been generally placed near *Actæa* or *Pæonia.* A.-L. de JUSSIEU (*Gen.* 234) says on this plant—"*Cimicifugæ affinis.*"

[3] PAYER (*Organog.*, 247). "There are," says he, "only very minute differences between the flowers of *Aquilegia* and *Xanthorhiza*, consisting, as they do, in the different number of whorls in the androceum on the one hand, and in the form of the petals on the other; and I can with difficulty understand why botanists have placed these two genera in different sections.

ovary, tapering above into a style which bears the stigma at its summit. Into the inner angle of the ovary are inserted a number of anatropous ovules, placed back to back in two vertical rows. The fruit is formed of several follicles, which may either be sterile,[1] or dehisce at the inner angle to free one or several seeds containing a fleshy albumen.

Xanthorhiza is a small shrub or undershrub which grows in damp localities in N. America. Its branches bear alternate complete leaves, with petioles sheathing at the base, and bearing a blade that is trifoliolate, or else has a terminal leaflet so deeply lobed as to appear like three leaflets, thus making the leaf pinnately compound. The indefinite branches bear at their summit a bud destined to lengthen out in the following year, covered by scales which represent the sheaths of the leaves.[2] The inflorescences which arise in spring from the axils of the scales or first-formed leaves, or which may really be terminal,[3] are racemose cymes with slender pendulous axes. The foliage of this plant resembles that of certain *Acteæ*, but its habit and woody stem appear to remove it from most *Ranunculaceæ*. The *Nigellæ*, on the contrary, return in this matter to the general characters of the order.

The first species we shall study of the genus *Nigella* is one that we shall term *N. Garidella*, which TOURNEFORT considered as the type



Nigella Garidella.

FIG. 15.
Flower.

FIG. 16.
Longitudinal section of flower.

of a separate genus, and which LINNÆUS named *Garidella Nigellastrum*.[4] Its receptacle is conical and bears successively a regular poly-

[1] This usually occurs in cultivation. There may be ten carpels in two whorls, and even twelve or thirteen, but a certain number disappear more or less completely. The plant may thus become polygamous.

[2] Some are surmounted by a rudimentary blade.

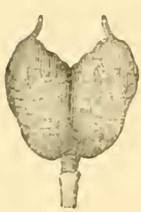
[3] When the inflorescence is terminal, below it we find one or two leaf-buds, axillary to scales. If later on one of these developes vigorously, it thrusts aside the raceme, making it appear lateral.

[4] *Nigella cretica folio Fœniculi* BAUH., *Pinax.*, 146.—*Garidella* T., *Inst.*, 655, t. 430.—J., *Gen.*, 233.—*G. Nigellastrum* L., *Spec.*, 608.—DC.,

sepalous calyx and polypetalous corolla, an indefinite number of stamens, and a di- or tri-carpellary pistil. There are five sepals quincuncially imbricated in the bud, and as many petals[1] offering the exceptional character of opposition to the sepals. The stamens are hypogynous and unequal, with the filament free and dilated at the tip below the insertion of the basifixed anther into two small lateral projections. The anther is bilocular, introrse, dehiscing by two longitudinal clefts, of which the outer lips turn sharply backwards after dehiscence. The stamens are arranged in eight radiating rows, each row containing but a very small number.[2] Each carpel is composed of a unilocular ovary surmounted by a short style, grooved longitudinally on the inside, while at the summit the margins of the groove turn somewhat outwards and are covered with stigmatic papillæ.

Nigella Garidella.
FIG. 17.
Diagram.

We notice within each ovary, which is united below to its neighbours, a parietal placenta, ventrally placed over a variable extent of the inner angle,[3] and bearing two rows of nearly horizontal anatropous ovules, with the raphes of those of each row adjacent to those of the other.[4] The pistils become as many follicles (figs. 18, 19), cohering for a variable height, and opening at the inner angle to free the seeds, which contain a small embryo near the



Nigella Garidella.
FIG. 18. Fruit.
FIG. 19. Fruit opening.

Prodr., i. 48.—SPACH, *Suit. à Buff.*, vii. 300.—ENDL., *Gen.*, n. 4793.—B. H., *Gen.*, 8, n. 22.

[1] These petals have a singular form. The claw is surmounted by a bifid fork-like limb, the inner surface of which is covered with clavate papillæ; and where this joins the claw is a nectariferous depression, the bottom of which is lined by a yellowish glandular tissue, and which is partly closed at its entry by a vertical acute scale, also bearing on its inner surface pedicellate papillæ. The singular form of these petals, and especially their position in front of the sepals, lead us to consider that perhaps they do not represent the elements of a corolla, but the outer stamens transformed into staminodes (*Adansonia*, iv. 29).—We have observed stamens in *Garidella*, which had on one side a fertile anther cell, and on the other a petaloid blade covered with papillæ.

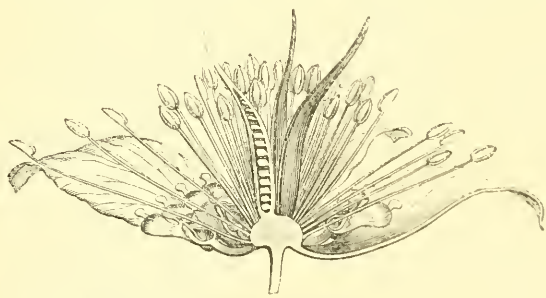
[2] There may be even only one or two in each row. But their arrangement is exactly the same as in the other *Nigellæ*. PAYER has also remarked (*Organog.*, 249) that the order of appearance of the eight inferior stamens of Garidella is the same as that of the eight petals of the Nigellæ.

[3] To be more exact we must, no doubt, say, that the carpels of *Garidella* are free, but that their bases are much extended obliquely, and are inserted on the three upper faces of a fairly elevated tetrahedron when they are three in number, and on the faces of a sort of acute projecting wedge when there are only two. The same observation applies to the other *Nigellæ*, as we have already indicated (*Adansonia*, iv. 21).

[4] They have two envelopes.

apex of the abundant fleshy albumen. The receptacle swells into a hypogynous disk of little thickness on a level with the insertion of the stamens, and also forms a projecting pad below the base of the calyx. *N. Garidella* is found in the countries of the Mediterranean; it is a herbaceous annual, with erect, angular stem and branches, leaves alternate, pinnately compound, much divided; flowers solitary, terminal.

The other *Nigellæ* only differ from *N. Garidella* in characters of but little importance, such as the larger number of parts in the corolla, androceum, and gynæceum. In fact, if we look at the flower of *N. arvensis* L. (figs. 20, 21), we see that the perianth is composed of five sepals and eight petals—a difference between the number in each whorl which is at first surprising. But on examining the relative positions of the sepals and petals, we see that while the lateral sepals have each a petal opposite them, as in *N. Garidella*, the three other sepals have each two petals before them. We must therefore consider that the *Nigellæ* have a corolla of five petals opposite the sepals, of which three undergo reduplication.[1] The stamens are formed and spirally arranged as in *N. Garidella;*



Nigella arvensis.

FIG. 20. Flower.

FIG. 21. Longitudinal section of flower.

but the secondary spirals, eight in number, which end opposite the base of the petals, are distinct and very marked; and hence the

[1] It even happens that in the *Nigellæ* cultivated in our gardens, all the petals may be doubled, and replaced by as many pairs, each opposite a sepal (see *Adansonia*, iv. 10). But as at the same time the petals have the same singular form as in *Garidella*, and are produced, not simultaneously, but successively in a spiral order like the parts of an androecum (PAYER, *Organog.*, 248); as each of these begins a row of stamens, as in *Eranthis*, &c.; taking also into consideration the opposition of the parts of the so-called corolla to those of the calyx, we are led to think that the *nectaries* of *Nigella*, as the older botanists termed them, represent staminodes, not petals—an interpretation that, moreover, in no way affects the symmetry of the flower.

stamens assume the appearance of organs superposed in vertical rows,[1] while each row is composed of a far larger number of stamens[2] than in *N. Garidella.* The gynæceum is composed of from four to five carpels, which do not correspond exactly to either the sepals or their intervals. They are inserted very obliquely by their bases on the tapering receptacle, so as to give them the appearance of being united into a many-celled ovary up to a certain height. Free above, they each taper upwards into a style, furnished towards the tip with stigmatic papillæ. Along the inner angle of each ovary is a multiovulate placenta as in *N. Garidella,* and the fruit consists of five follicles united below and dehiscing by the inner angle.

While all the other *Nigellæ* have blue or whitish flowers, *N. orientalis* L., which has been made the type of a small separate group,[3] has them yellowish, with stamens closer together, retaining the appearance of a spiral arrangement, though not divided into groups. The carpels are very variable in number (figs. 22 and 23), and are only united by the lower portion of their ovaries. The seeds are flattened, orbicular, and bordered by a narrow membrane.

N. orientalis.
FIG. 22.
Fruit.

N. hispanica.
FIG. 23.
Fruit.

N. damascæna L., which is cultivated in our gardens, has been considered the type of a special genus under the name of *Erobatos,*[4]

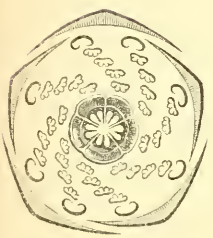
[1] "After the expansion of the flower," says PAYER (*Organog.*, 218), "the staminal radii seem alternate with the petals; but this is only in appearance, as they are truly superposed when young." These stamens arise successively in a spiral order, the same as the petals or nectaries, which only confirms us in our opinion that they are organs of the same nature. The anthers are introrse, and open like those of the Columbines. But the line of dehiscence is not in the middle of the cell, and the exterior wall, which is turned back outwards is much broader than the interior. This is the only difference.

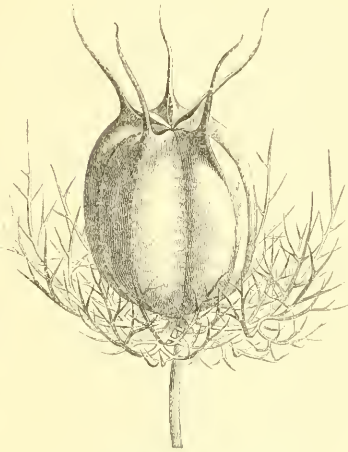
[2] In our gardens the flowers often become more or less double; all the stamens, or a limited number of them beginning below, are transformed into petaloid scales, as appears to be normal with the eight or ten lowest stamens.

[3] *Nigellastrum* MŒNCH, *Meth.*, 311, 313.—SPACH, *Suit. à Buff.*, vii. 310. The number of carpels varies from five to ten and even more in *N. orientalis.* The ovaries are narrow, compressed against one another, and each surmounted by a tapering, erect, straight style. In *N. corniculata* DC., which belongs to the same section, they are bent outwards. The carpels may be only two or three in number in this species, as in *Garidella.*

[4] See SPACH, *Suit. à Buff.*, vii. 301. *Erobatos* is there considered as a distinct genus, while DE CANDOLLE only makes it a section of the genus *Nigella.* *N. coarctata* GMEL., which we have seen cultivated, does not appear to us to differ specifically from *N. damascæna.*

on account of the organization of its ovary and the structure of its fruit (figs. 24–26). The cells of the ovary, usually five in number,





Nigella damascæna.

FIG. 24. Diagram.

FIG. 25. Fruit.

FIG. 26. Transverse section of fruit.

are united for nearly their whole length,[1] and are surmounted by as many free, acute, persistent styles.[2] The fruit is a capsule, dehiscing when ripe by five longitudinal clefts which pass through the middle of the summit of each cell and the base of the style. Moreover the convex walls of these cells separate into two layers, of which the outer retains its normal position, while the inner enwraps the seeds.[3] Hence results outside of each cell a false cell formed in the thickness of the pericarp itself. The ovules are numerous, in two vertical rows.[4] They become seeds with a wrinkled or rugose surface, containing a small embryo near the apex of the abundant fleshy albumen.[5]

All these plants, which we unite into the one genus *Nigella*,[6] are annual herbs, indigenous in the temperate regions of Europe and

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[1] DE SCHLECHTENDAL (*Bot. Zeit.*, No. 51, Dec. 1857), has found plants with abnormal carpels, cohering but little at their base, as in fig. 21.

[2] Along the inner border of the style runs a longitudinal groove with stigmatiferous lips. These at a certain age are twisted on themselves near the tip.

[3] This layer consists only of pretty irregular cells, with well marked outlines. In cultivation the *Nigellæ* often bear proliferous fruits. The axis, after producing normal carpels, elongates a little to produce others interior to these.

[4] The coats of these ovules are impregnated with an orange yellow colouring matter, which disappears in the ripe seeds.

[5] These seeds have a pungent taste like those of most *Nigellæ*; especially *N. sativa*, which is used instead of pepper.

[6] *Nigella* T., *Inst.*, 258, t. 131.—L., *Gen.*, n. 685.—JUSS., *Gen.*, 233.—DC., *Prodr.*, i. 48.—SPACH, *Suit. à Buff.*, vii. 304.—ENDL., *Gen.*, n. 4794.—PAYER, *Organog.*, 217, t. liv.—B. H., *Gen.* 8, n. 22.—H. BN., *Adansonia*, iv. 44.

Western Asia.[1] They have alternate pinnatifid leaves, much dissected, with narrow segments; in *N. damascæna* they are transformed into bracts, and form an involucre below the calyx (figs. 25, 26). The flowers are solitary, terminal.

The *Nigellæ*, therefore, differ chiefly from the Columbines in the more or less complete union of their carpels, in the peculiar arrangement of their stamens, and in the opposition of the petals or nectaries to the sepals. The Hellebores[2] differ still less from the *Nigellæ*, for if we except the difference of habit and growth, we find that the only want of resemblance between the two types is in the form of the petals or nectaries, the degree of cohesion of the carpels, and the organization of the ovules. We may convince ourselves of this by analysing first the common Bear's-foot (*Helleborus fœtidus; Fr.* Pied de Griffon).

Fig. 27.
Helleborus fœtidus.

Helleborus fœtidus L.[3] has hermaphrodite, regular flowers, with a conical receptacle, which bears successively from below upwards the calyx, the corolla, the androceum, and the gynæ-

[1] Gren. & Godr., *Fl. Fr.*, i. 43. — Walp., *Rep.*, i. 49; ii. 741; *Ann.*, i. 12; ii. 11; vii., 28.—Reichb., *Icon.*, iv. t. 120.

[2] *Helleborus* T., *Inst.*, 271, t. 144.—Adans., *Fam. Pl.*, ii. 458.—L., *Gen.*, n. 702.—Juss., *Gen.*, n. 233.—DC., *Prodr.*, i. 46.—Spach, *Suit. à Buff.*, vii. 312.—Endl., *Gen.*, n. 4789.—Payer, *Organog.*, 258, t. lvii.—B. H., *Gen.* 7, n. 18.—H. Bn., *Adansonia*, iv. 44. — *Helleboraster* Mœnch, *Meth.*, 236.

[3] *Spec.* 784.—Sect. *Griphopus* Spach, *loc. cit.*—See Is. Dumas, *Quelques mots sur la Structure de l'H. fétide* (*Thèses de Montpellier*, 1844).

ceum. The calyx is composed of five sepals, green, or tinged with purple, of quincuncial æstivation (fig. 28). The corolla is sometimes formed of five petals[1] alternate with the sepals. They have the shape of a horn, with a dentate opening sloping downwards and inwards. The base of the tube is dilated into a rounded pouch, of which the glandular lining secretes nectar. The very numerous stamens arranged in a continuous spiral have free filaments, and basifixed, two-celled, extrorse anthers dehiscing longitudinally. The gynæceum is formed of three[2] free[3] carpels, opposite the anterior petal and the two posterior ones, each composed of a unilocular ovary tapering above into a style, whose somewhat dilated apex is covered with stigmatic papillæ.[4] Along the whole length of the inner angle of the carpel is a vertical groove, and within the cell of the ovary is a placenta occupying its inner angle, and supporting two rows of horizontal ovules placed back to back.[5] The fruit is composed of as many follicles[6] as there were

Helleborus fœtidus.

FIG. 28. Flower-bud.

FIG. 29. Petal.

[1] This equality of number with the sepals is not most usually observed. The number varies, not only in this species, but also, as we shall see, in the other species of this genus. As to the name of 'petal' which we have applied to these organs, we have used it here only with great hesitation, and we have grounds for thinking that, by analogy with *Nigella, Trollius*, and especially *Eranthis*, these nectaries, as they used to be called, represent the lower or outermost stamens, transformed into staminodes of a form not more surprising than that observed in the same organs of the genera above described. The arrangement, too, of these staminodes answers to that of the fertile stamens, of which they begin the series. The symmetry of all these parts has been studied very exactly by PAYER (*Organog.*, 258), whose observations on this subject we here sum up. The nectaries of certain Hellebores, as *H. niger*, are arranged in twenty-one rays, extending from the circumference towards the centre, whose angular divergence is $\frac{8}{21}$. The fertile stamens continue this spiral as also the carpels. In some other species there are usually only five nectaries, beginning five rows of stamens alternate with the sepals, and this number, we used to say, might be observed in *H. fœtidus*. But here, eight may be more often counted, one corresponding as in *Nigella* to sepal 4 and one to sepal 5, while two are opposite to each of the other sepals. When only seven, six, or five are seen, it is simply owing to the fact that the transformation into staminodes has not been effected on the first stamen of one, two, or three of the rays. Besides, the number of staminodes only very rarely indicates the number of fertile stamens, for in *H. fœtidus*, which has often only from five to eight nectaries, and rarely more, there are six rows of stamens before sepals 4 and 5, five before sepal 3, and two before sepals 1 and 2.

[2] There are rarely more than three, four, or five opposite the sepals; but two are pretty often seen, one posterior, and the other nearly anterior.

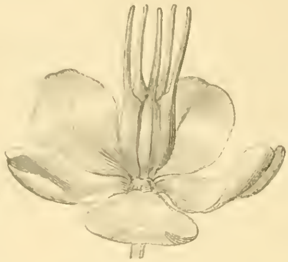
[3] *H. vesicarius* AUCH.—BOISS. has the carpels united half way up when ripe, as in certain *Nigellæ*.

[4] The styles have their tips at first reflexed, and covered with whitish stigmatic papillæ. Later the style becomes erect and blackish.

[5] These ovules have but one envelope. They are remarkable for the conical form of the very thick raphe, projecting and fleshy towards its base.

[6] The dehiscence of these follicles is not that usually seen, when the placenta separates into two bands, which adhere to the borders of the opened out carpellary leaf. Here both borders of this separate from the placenta from above downwards. The placenta then remains free, as a whitish fleshy column supporting the two rows of seeds. These are black and smooth, with a thick projection formed by the white fleshy raphe.

carpels, surrounded by the persistent calyx, and containing seeds with minute embryos, and abundant fleshy albumen.



Helleborus fœtidus.

FIG. 30. Longitudinal section of flower.

FIG. 31. Calyx and gynæceum.

H. fœtidus is a perennial with erect branches arising from a fleshy stock, covered with alternate dissected leaves with their petioles dilated at the base.[1] The flowers are grouped in few-flowered cymes at the top of the upper branches, the whole forming a kind of thyrsus. The lowest leaves of the branches and the bracts are reduced to dilated flattened petioles. Large bracts are seen also in an intermediate stage, having a very much reduced blade at the summit.

Other Hellebores cultivated in our gardens, as *H. odorus* W. & K., *viridis* L., *orientalis* GARS., have erect branches bearing solitary terminal flowers, or few flowered cymes, with some dissected leafy bracts. Another species, often cultivated under the name of "Christmas Rose" (*H. niger* L.), is distinguished by its quite peculiar habit and the absence of any leaves but bracts on its floriferous branches. It has a petaloid calyx, and about thirteen horn-shaped nectaries, with irregularly crenulate mouths, supported on slender claws.[2] The anthers open by two longitudinal sublateral clefts.[3] There are from five to ten carpels. The flowers may be solitary at the end of the peduncle, which bears two alternate bracts ; one of these, however, is often fertile, a secondary axis springing from its axil, also with two bracts below its terminal flower.[4]

The subterranean part of the Christmas Rose is a ramified stem bearing alternate scales or their scars, near which the branches develope adventitious roots. Each of the branches ends in an

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[1] All these parts exhale a fetid odour, owing to the liquid secreted by little glands spread over the leaves, the calyces and the axes.

[2] The bottom of this nectary, thickened and glandular, secretes a sweet liquid in abundance. Its opening is truncated obliquely downwards and inwards.

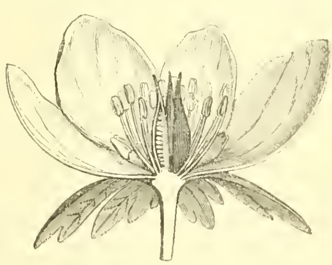
[3] These clefts are rather interior than exterior, and the connective is seen only on the outside of the anther. The pollen is elongated, as in all these plants, with three equidistant (rarely two or one) longitudinal grooves.

[4] Sometimes too, under each flower we have three alternate bracts, two of which may be fertile.

inflorescence, ceasing to grow after the death of the flowers; it remains truncated; its evolution is finished. But in the axils of the leaves or bracts of this axis are developed shoots, which are larger according as they rise higher up the stem. These shoots are in turn destined in following years to end in inflorescences, and their axes will then develope adventitious roots to nourish them. So, too, it is in the axils of the appendices of these axes that will appear the shoots of a subsequent generation. Thus, on examining a plant which has flowered for several years, we find the floral peduncles grouped on a small branch which serves as a common support. This bears at its base alternate imbricate scales which represent sheathing petioles, with sometimes a rudimentary blade, or else more rarely near the base we may find a true leaf with its sheath and petiole, and its blade formed of free leaflets, as often occurs in this species.[1]

Near *Helleborus* are placed *Eranthis* and *Coptis*, which, it appears to us, should not be generically separated from it, as the detailed analysis of their flowers will show.

Helleborus hyemalis L.[2] (figs. 32, 33), which has been taken as the type of the genus *Eranthis*,[3] has a petaloid perianth consisting of two trimerous whorls, the leaves of which are alternate, or more rarely, twisted in æstivation. The androceum is composed of a



Helleborus hyemalis.

FIG. 33. Longitudinal section of flower.

FIG. 32. Flower.

[1] The development of the leaves of the Hellebores has been studied by M. TRÉCUL (*Ann. Sc. Nat.*, *sér.* 3, xx. 260, 268, t. 23), who considers them as palmiveined leaves, very deeply lobed, and passing into palmate leaves properly so called; their evolution is basipetal or centrifugal. CLOS comparing the sepals with the bracts (*Bull. Soc. Bot.*, iii. 682), considers them as the sheaths of leaves.

[2] *Spec.*, 783.—DC., *Syst.*, i. 314.—*H. niger tuberosus Ranunculi folio flore luteo* T., *Inst.*, 272.—*H. monanthus* MŒNCH.—*Kallea hyemalis* BIR.—*Robertia hyemalis* MER.

[3] *Eranthis* SALISB., *Trans. Linn. Soc.*, viii.

large number of stamens spirally arranged,[1] but forming twelve secondary radiating rows in the following positions[2]—1st, three rows opposite each of the outer sepals; 2ndly, one row opposite each interior sepal. All the stamens of the rows opposite the interior sepals are fertile, each consisting of a free filament, somewhat dilated at the tip, supporting a basifixed bilocular introrse anther dehiscing longitudinally.[3] But in six of the other rows the outermost stamen is transformed into a little spur or nectary like that of other Hellebores[4] (fig. 29). The gynæceum is composed of six carpels[5] opposite these staminodes, and formed like those of the true Hellebores. The fruits are follicles dehiscing early[6] to free the numerous seeds.[7] Each follicle is raised on a narrow pedicel, in contact with, but not cohering to the pedicels of its neighbours. The whole is surrounded by a persistent calyciform involucre,[8] the three leaves of which alternate with the outer pieces of the perianth. The organs of vegetation of *H. hyemalis* consist of a shortened rhizome[9] like that of other Hellebores bearing adventitious roots, and shoots with leaves and flowers. The flowers arise from the ground in winter, supported on a peduncle which it terminates, and closely surrounded by the involucre of three compound leaves, alternate with the outer sepals referred to above. The radical leaves, few in number, and withering very early, are alternate, palmiveined, and dissected. We know but very few species of *Eranthis*

(1807) 303. — DC., *Prodr.*, i. 46. — SPACH, *Suit. à Buff.*, vii. 321.—ENDL., *Gen.*, n. 4788. —PAYER, *Organog.*, 256.—H. BN., *Adansonia*, ii. 203, iv. 47. — B. H., *Gen.*, 7, n. 19.— *Helleboroides* ADANS., *Fam. Pl.*, ii. 458.

[1] This order is very evident in the young flower-bud.

[2] PAYER, *Organog.*, *loc. cit.*

[3] The anther opens by two internal somewhat oblique clefts, after which each cell spreads out edgewise as in Columbine. It usually even happens that the inner margin of the opened cell becomes more or less involute, and the outer margin revolute.

[4] In form like a stalked cornet, with its orifice truncated obliquely downwards and inwards, and the lower and inner margin emarginate. The inside contains nectar. The origin of these bodies, shown for the first time by PAYER (*l. cit.*), who did not consider them as petals, and was hence led to regard as such the outer pieces of the perianth, this, we say, well shows the nature of the so-called petals in the Hellebores themselves and in many other *Ranunculaceæ* (See *Adansonia*, iv., 19).

[5] The usual number; rarely five, oftener from seven to ten in cultivated plants.

[6] Often nearly a month after flowering, that is to say, at the end of the winter.

[7] These seeds are at first soft, with very thin coats, and very abundant fleshy albumen. They often attain maturity without the embryo becoming developed; it remains very small and deformed, probably through not having been fecundated. Often, too, *Eranthis* like *Ficaria* produces no fruit.

[8] PAYER (*l. cit.*) considers that this verticil represents a calyx. In this respect *Eranthis* is very analogous to *Hepatica*, showing that in *Ranunculaceæ* there is an insensible transition from involucre to calyx, from calyx to corolla, and from corolla to androceum; which indicates, as we have stated, a sort of organic inferiority (See our article on *Anemone* below, and *Adansonia*, iv. 6).

[9] PAYER, *Hist. de la vég. de l'*Eranthis (*Bull. Soc. Phil.*, April 27, 1844, 35).

all indigenous in hilly, cold, or temperate regions of Europe and Asia.[1]

Finally, the Eranthids are Hellebores, whose perianth consists of two trimerous whorls, instead of five pieces quincuncially arranged. We also shall observe this in certain species of *Ranunculus*, *Anemone*, and *Pæonia*, without being able to put the species possessing a hexamerous perianth into separate genera.

Helleborus trifolius.
FIG. 34.
Flower.

In the flowers of *Helleborus trifolius* L. (fig. 34),[2] which has served to found a separate genus under the name of *Coptis*[3] *trifolia*,[4] we still note the general features of the Hellebores; the perianth is composed of five, six, or, more rarely, four petaloid leaves, imbricated in the bud. Within are a variable number of petals or staminodes, represented by small stipitate cups of a fleshy and somewhat glandular consistency.[5] The stamens are indefinite, with unequal filaments supporting basifixed anthers which dehisce laterally. The carpels, which vary in number,[6] are stipitate, multiovulate, and surmounted by a style reflexed and dilated at the summit. The fruits are follicles. We must therefore consider *Coptis* as a Hellebore with stipitate carpels, often few in number. They are perennial herbs, found in the northern regions of both hemispheres. Their stem is a rhizome of little thickness, creeping below ground, from which arise buds here and there, which expand at the surface. They have

[1] GREN. & GODR., *Fl. Fr.*, i. 40.—REICHB., *Icon.*, iv. 101.—WALP., *Rep.*, i. 47; *Ann.*, iv. 29.

[2] *Amœn. Acad.*, ii. 355, t. 4, f. 18; *Spec.*, 784, —DC., i. 322.—*Anemone grœnlandica* L., *Fl. Dan.*, t. 566.

[3] *Coptis* SALISB., *in Trans. Linn. Soc.*, viii. 305.—DC., *Prodr.*, i. 47.—SPACH, *Suil. à Buff.*, vii. 324.—ENDL., *Gen.*, n. 4792.—WALP., *Rep.*, i. 49.—B. H., *Gen.*, 8, n. 20.—H. BN. *Adansonia*, iv. 47.

[4] SALISB., *l. cit.*—BIGEL, *Bot. Med.*, i. 60, t. 5.—SIEB. & ZUCC., *Fl. Jap. Fam.*, 71.—A. GRAY, *Ill.*, t. 13.—*Chrysa*, RAF. (*New York Med. Repos.*, ii. *hex.* v. 350.)

[5] In other species these organs assume the form of linear scales: e.g., *C. occidentalis* TORR. & GR., of which NUTTALL (*Journ. Ac. Philad.*, viii. 9, t. 1) has made his genus *Chrysocoptis*. Others, as C. *asplenifolia* SALISB. have them dilated about half way up. These belong to a group called *Pterophyllum* NUTT.

[6] Sometimes there is but one; while as many as ten have been counted.

a few alternate leaves with the blade trifoliolate, or even more divided, and often one or several united one- or few-flowered floral peduncles.

Isopyrum,[1] which most authors consider as a distinct genus, should strictly be replaced in the genus *Helleborus*, in which it was formerly included. Its habit (which, however, is very near to that of *Coptis*),[2] with some characters of slight importance offered by the flower, may, it is true, be enough to separate them. We have retained it provisionally only,[3] as a "transition genus between *Nigella* and *Helleborus*, ill-defined, and without good natural limits." The analysis of the commonest species will show if this way of regarding it is justified.

Isopyrum fumarioides.
Fig. 35.
Flower.

Isopyrum fumarioides L.[4] (fig. 35), has regular hermaphrodite flowers. The calyx is formed of five coloured sepals, of quincuncial æstivation. The corolla is composed of five tubular petals, of which the base tapers into a kind of pedicel, while the limb divides into two lips, of which the inner is the shorter, and indented in the centre or *emarginate*. The stamens, of a fair number, are free and hypogynous. Each consists of a filament somewhat dilated at the tip, and a basifixed anther with two cells dehiscing by lateral clefts, hardly more interior than exterior. The gynæceum consists of a large number of carpels, the ovaries of which are grooved vertically for the whole length. On a level with the tapering summit of the ovary, the lips of this groove thicken slightly, and become covered with papillæ to form a small stigma. In the inner angle of the single cell of the ovary is a parietal placenta, bearing a large number of anatropous ovules in two vertical rows. The fruit is formed of numerous small follicles, and the seeds enclose in their integuments a small embryo surrounded by, and at the apex of, the very abundant fleshy albumen. It is a herbaceous annual, a native of Siberia. It has a tap-root, and the base of the stem gives off numerous alternate leaves, with the petiole dilated at the base, and

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[1] *Isopyrum* L. *Gen.*, n. 701.—Juss., *Gen.*, 233.—DC., *Prodr.*, i. 48.—Spach, *Suit. à Buff.*, vii. 326.—Endl., *Gen.*, n. 4790.—B. H., *Gen.*, 8, n. 21.—Walp., *Rep.*, i. 48, ii. 741; *Ann.*, i. 954, ii. 11, iv. 26.—H. Bn., *Adansonia*, iv. 26, 46.

[2] Bentham & Hooker go so far as to say of Coptis "*Genus forte melius pro sectione* Isopyri *habendum.*"

[3] *Adansonia*, iv. 46.

[4] *Spec.*, 783.—DC., *Prodr.*, i. 48, n. 3.—*Leptopyrum.* Reichb., *Fl. Germ.*, 747.—Spach, *Suit. à Buff.*, vii. 327.

the blade trifoliolate, with radiating pinnately compound leaflets. The stem then ascends to terminate in a flower, below which we find one or several leaves, from the axils of which spring branches, each also ending in a flower, and so on. These floral leaves have a very short petiole, with two lateral membranous appendages at the base, which undoubtedly represent stipules; and these in the cauline leaves, which have a well-developed sheath, are reduced to two lateral teeth on the borders of the upper part of this sheath.

Isopyrum thalictroides L.,[1] has regular hermaphrodite flowers, with a calyx of five coloured sepals imbricated in the bud, and a corolla of five petals alternate with and much smaller than the sepals, cornet-shaped, with the opening obliquely truncated at the expense of the inner border, glandular and nectariferous at the bottom. The stamens are very numerous, hypogynous, unequal, with free filaments and basifixed two-celled anthers, dehiscing by longitudinal and lateral clefts, rather extrorse than introrse. The gynæceum is composed of two or three free carpels, and in the inner angle of each ovary is a vertical placenta bearing the ovules, few in number, and with their raphes facing one another in two vertical rows, each usually of only two ovules. It is a small plant, with a horizontal rhizome, from which spring young herbaceous branches bearing a few alternate compound leaves, accompanied by two lateral stipules. The leaves at the top of the young branch degenerate into bracts, from the axil of each of which springs a solitary pedicellate flower; thus is formed a small raceme.

The petals or nectaries, already little developed in the species we have just studied may disappear entirely, as in many other genera of *Ranunculaceæ*—the only character of any value which distinguishes *Enemion biternatum*[2] from the other species of *Isopyrum*, with which we class it. The number of ovules in each carpel is very variable, there being sometimes but one or two (fig. 36) horizontal, with the raphe superior; or the number may be indefinite. *Enemion* inhabits North America.

Enemion biternatum.
FIG. 36. Carpel opened.

[1] *Spec.*, 783.—DC., *Prodr.*, i. 48, n. 1.—GREN. & GODR., *Fl. Fr.*, i. 42.—*Olfa* ADANS., *Fam. Pl.*, ii. 458.—*Thalictrella* A. RICHARDSON, *Dict. Hist. Nat.*, ix., 34. Sect. *Evisopyrum* H. BN., *Adansonia*, iv., 47.

[2] RAFIN., *Journ. Phys.* (1820), 91, 70.—DC., *Prodr.*, i. 48.—ENDL., *Gen.*, n. 4791.—WALP., *Ann.*, ii. 11.—A. GRAY, *Ill.*, t. 12.—B. H., *Gen.* 8, n. 21. H. BN., *Adansonia*, iv. 25, 46.

Trollius,[1] again, is a genus admitted by all, but very little marked, and without any good distinction from the Hellebores. If, in fact, we examine the flower of *T. asiaticus* L., often cultivated in our gardens, we shall see that it has often a petaloid calyx of five imbricated sepals,[2] and five short thickened petals[3] or nectaries, grooved on the inner face, at the base of which is a glandular projection which secretes nectar. The stamens, very numerous and spirally arranged, have a free filament and a basifixed anther, rather extrorse than introrse.[4] The indefinite carpels are multiovulate, and the anatropous ovules[5] are in two vertical rows, and touch by their raphes.

Therefore, the only difference between these flowers and the Hellebores is that the nectaries are not tubular or cup-shaped. We find specimens of *Trollius*, in which the sepals become very numerous, and others in which the nectaries, are also indefinite in number (fig. 37). The sepals are more or less caducous, but persist longer in *Hegemone*,[6] which cannot on that account be generically separated from *Trollius*. In all of them the fruits are follicles.[7] They are perennial herbs with subterranean rhizomes, and palmiveined, lobed, or dissected alternate leaves; flowers solitary terminal, or few in number and arranged like those of *Aquilegia* or *Nigella*. They inhabit the northern hemisphere in both Worlds, and are especially common in northern Asia.[8]

Like nearly all the preceding genera, this may present flowers

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[1] *Trollius* L., *Gen.*, n. 700.—Juss. *Gen.*, 233. Lamk., *Ill.*, t. 449.—DC., *Prodr.*, i. 45.—Spach, *Suit. à Buff.* vii. 296.—Endl., *Gen.*, n. 4787. —B. H., *Gen.*, 7, n. 17.—H. Bn. *Adansonia*, iv. 48.—*Hellebori* spec., T., *l. cit.*—*Geisenia* Raf., *New York Med. Rep.* (v.), ii. 450.

[2] More usually there is a larger number of these organs, especially in cultivated plants.

[3] This number is relatively rare. More often we find five groups of two, three, or more of these scales. In *T. americanus, europæus, asiaticus*, they have the shape of a racket, but with the handle narrower and the body longer in proportion, grooved by a canal above. The top is truncated horizontally or obliquely, rounded or emarginate. In *Hegemone* they are nearly flat, spathulate blades.

[4] In *T. americanus* and many others the inner stamens are the shorter; the line of dehiscence is a little turned outwards. In *T. asiaticus* this line is quite on the margin. The connective is at first broad and flattened. That of *T. americanus* becomes afterwards concave externally, and in the same way the two cells of *T. europæus*, in the end project towards the perianth.

[5] They have two coats.

[6] *Hegemone lilacina* Bunge, Ledeb., *Fl. Ross.*, i. 51.—*T. lilacinus* Bunge, *Fl. Alt.-suppl.*, 44.

[7] The follicles, united into a more or less compressed head, are either smooth or wrinkled transversely, and surmounted by the remains of the style, which is placed on the side opposite the line of dehiscence. The seeds are smooth, shining, and dark in colour. The outer envelope is reticulate and minutely punctate; the inner, white and cellular. The raphe projects but little. The albumen is fleshy and copious, with a very small embryo near the apex.

[8] Gren. & Godr., *Fl. Fr.*, i. 40.—Reichb., *Icon.*, iv. t. 102.—A. Gray, *Ill.*, 11.—Hook. & Th., *Fl. Ind.*, i. 41.—Walp., *Rep.*, i. 47, ii. 740, *Ann.*, iv. 29.

without the petals or nectaries (fig. 38); this is the only distinguishing feature of *Calathodes*,[1] a perennial herb of the eastern Himalayas.

Trollius chinensis.
FIG. 37.
Flower.

Calathodes palmata.
FIG. 38.
Flower.

Caltha,[2] too, has the apetalous flowers of *Calathodes*. Its perianth consists of only five[3] petaloid sepals of quincuncial æstivation (fig. 39). It has very numerous stamens with basifixed two-celled

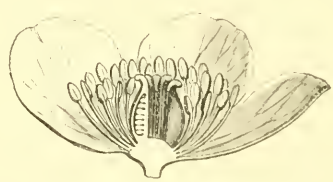

FIG. 39.
Flower.

Caltha palustris.

FIG. 40.
Longitudinal section of flower.

extrorse anthers, and indefinite multiovulate carpels. It is therefore simply a *Trollius* without the corolla or whorl of nectaries. The organs of vegetation alone are affected by the medium the plants inhabit, for they are aquatic, sometimes floating,[4] perennial herbs.

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[1] *C. palmata* (HOOK. & TH., *Fl. Ind.*, i. 40.—WALP., *Ann.*, iv. 29.—B. & H., *Gen.*, 7, n. 14.—H. BN., *Adansonia*, iv. 48) has the habit of a *Trollius*, with the flowers of a *Caltha*. The flowers have four or five imbricated sepals, unequal stamens with anthers dehiscing laterally (a little extrorse), and a very variable number of carpels.

[2] *Caltha* L., *Gen.*, n. 703.—JUSS., *Gen.*, 234.—PERS., *Enchir.*, ii. 107.—DC., *Prodr.*, i. 44.—ENDL., *Gen.*, n. 4786.—SPACH, *Suit. à Buff.*, vii. 293.—B. H., *Gen.*, 6, n. 13.—H. BN., *Adansonia*, iv. 48.

[3] Their number is often greater, rarely reduced to four. They persist in certain species, but are caducous in *Psycrophila*. When there are five, their æstivation is usually quincuncial, but they may be otherwise imbricated. The flower often becomes double in *C. palustris* (T., *Inst.*, 273, t. 24). The stamens are then converted into small imbricated petals, while the receptacle is often deformed (*Adansonia*, iv. 5), and becomes concave, as in the Pæonies.

[4] *C. natans* PALL., *Voy.*, ed. min., iii. 248.—DC., *Prodr.*, i. 45, n. 11.—*Thacla ficarioides* SPACH, *Suit. à Buff.*, vii. 295.

From the rhizome arise branches bearing alternate leaves. In *C. palustris* L.,[1] these are petiolate and have at the base a sort of sheath like a membranous frill. The blade is cordate, suborbicular, or reniform, feather veined, crenulate, plane; while in other species which have been made the type of the genus *Psycrophila*,[2] this blade has lobes projecting in the form of internal auricles. The rest of the organization is entirely the same. The flowers are solitary and terminal, or grouped on the axes as in the species belonging to *Trollius* proper. The fruits are follicles, which dehisce by the inner border to set free numerous seeds covered externally by a well-developed arilloid production (figs. 41, 42) arising from the great thickening of their external integuments.[3]

Caltha palustris.
FIG. 41. Seed. FIG. 42. Longitudinal section of seed.

Thus constituted,[4] our genus *Trollius* also comprises Indian Alpine plants like *Calathodes* and aquatic plants—the true *Caltha* which inhabit the cold or temperate regions of both Worlds,[5] and *Psycrophila* found in the cold Antarctic Zone.[6]

On account of the multiovulate carpels, botanists have agreed in

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[1] *Spec.*, 784.—DC., *Prodr.*, i. 44, n. 3.—*Populago* T., *Inst.*, 273, t. 14, t. 145. The style has two lateral stigmatiferous lips. The ovules have two envelopes.

[2] DC., *Syst.*, i. 307.—C. GAY, *Fl. Chil.*, i. 47, t. 2.

[3] Contrary to what is seen in many arillate seeds where the aril consists of a cellular thickening of the outer coat, limited to the upper part (as is the case especially in the formation of carunculæ in the *Euphorbiaceæ*), in *Caltha* it is at the chalazal end that this hypertrophy gradually takes place; so that the rest of the integument remains very thin in proportion towards the hilum and micropyle. Figs. 41, 42 will illustrate this better than any possible description.

[4] *Trollius.* Sections 5.
1. *Eutrollius.* Leaves much dissected. Flowers with a corolla, calyx caducous.
2. *Hegemone* (BUNGE). The same, but calyx persistent.
3. *Calathodes* (HOOK. & TH.). Flowers apetalous. Leaves dissected.

Trollius. Sections 5. *cont.*
4. *Caltha* (L.). Aquatic plants. Flowers apetalous. Leaves little cut up. Calyx persistent.
5 *Psycrophilia* (DC.). Same, but leaves with lobes projecting inwards. Calyx caducous.

[5] GREN. & GODR., *Fl. Fr.*, i. 39.—REICHB., *Icon.*, iv. 101.—HOOK. & TH., *Fl. Ind.*, i. 39.—A. GRAY, *Ill.*, t. 10.—BENTH. & MUELL., *Fl. Aust.* i. 15.

[6] C. GAY, *Fl. Chil.*, i. 47-51.—HOOK. F., *Fl. Antarct.*, ii. 228, t. 84.—WEDD., *Chlor. And.*, ii. 306, t. 82.

It is only with great hesitation that we have placed (*Adansonia*, iv. 57) the genus *Anemonopsis* S. & ZUCC. (*Fl. Jap. Fam.*, 73, t. 1.—*Xaveria* ENDL., *Gen.*, suppl. iv. 30), altogether unknown to us, near the dichlamydeous sections of *Trollius*. Its characters are as follows: Regular flowers in lax racemes, recalling those of a double Anemone. They possess a calyx of several leaves, the three outer sepaloid, the inner ones petaloid; about twelve short sessile petals, having a nectariferous hollow in the thickened base; indefinite

including in this group *Glaucidium palmatum* S. & Zucc.,[1] the single species of a genus which, as we shall afterwards see, evidently links *Ranunculaceæ* to *Berberidaceæ* and *Papaveraceæ*. Its flowers are hermaphrodite, and on the convex receptacle are successively inserted a calyx, an androceum, and a gynæceum. The calyx consists of four free petaloid imbricated sepals, very caducous, as are also the very numerous stamens, each of which consists of a free filament, and a basifixed two-celled anther dehiscing by lateral clefts. The gynæceum is formed of one or few carpels[2] inserted obliquely on the upper tapering portion of the receptacle, and containing a large number of anatropous ovules inserted along the inner angle. The ovary is traversed by a longitudinal groove and surmounted by a depressed emarginate papillose stigma. The fruit is formed of one or several follicles dehiscing dorsally, with numerous flattened seeds surrounded by a marginal wing. It is a perennial herb found in Japan, with few alternate palmatilobed leaves, and pedunculate flowers recalling those of *Podophyllum*.[3]

IRREGULAR FORM.

If we examine an Aconite,[4] as, for instance, *A. Napellus* L., we see that its flowers (figs. 43–47) are irregular and hermaphrodite. The calyx is formed of five unlike coloured sepals, quincuncially imbricated in the bud. The posterior sepal is like a hood covering the two lateral sepals, which are symmetrical with respect to each other, hardly irregular, and much broader than the two anterior ones, by which they are also covered in the bud. These anterior sepals are narrower and longer than the lateral ones, but are not altogether similar to one another,[5] for sepal 3 is both broader and less regular than sepal 1, which overlaps it on one side. There

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stamens with linear compressed filaments, and mucronate anthers quadrilocular (?) in front. The carpels, few in number, are multiovulate; and the fruits are, it is said, capsular. Only one species is known, native in Japan; *A. macrophylla* S. & Zucc., which is a herb with broad ternately compound radical leaves. See H. Bn. *on the Genus* Anemonopsis, *its Position and Affinities*, *Adansonia*, viii. 14.

[1] *Fl. Jap. Fam. Nat.*, i. 76, t. 1.—Endl., *Gen.*, n. 4804[1].—Walp., *Ann.*, i. 955.—B. H., *Gen.*, 7, n. 15.

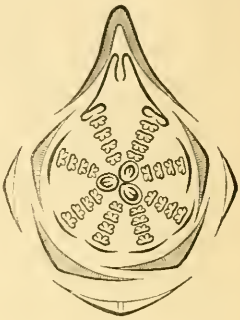
[2] Siebold and Zuccarini have represented the plant with a single carpel. In the few flowers we have been able to observe, there were two inserted obliquely opposite one another on a receptacle bevelled to form a dihedral angle.

[3] It is to the *Podophylleæ*, we have said (*Adansonia*, iv. 57), that this plant presents a striking likeness when its gynæceum is of one carpel.

[4] *Aconitum* T., *Inst.*, 424, t. 239, 240.—L., *Gen.*, n. 682.—J., *Gen.*, 234.—DC., *Prodr.*, i. 56.—Spach, *Suit. à Buff.*, vii. 360.—Endl., *Gen.*, n. 4797.—B. H., *Gen.*, 9, n. 26.—H. Bn. *Adansonia*, iv. 50; *Dict. Enc. Sc. Méd.*, i. 574.—*Nirbisia* Don, *Gen. Syst.*, i. 203.—Endl., *Gen.*, n. 4786 a.

[5] See *Adansonia*, iv. 9, 50.

are eight[1] petals originally disposed like those of *Nigella*, but the two opposite the posterior sepal alone receive any marked development.



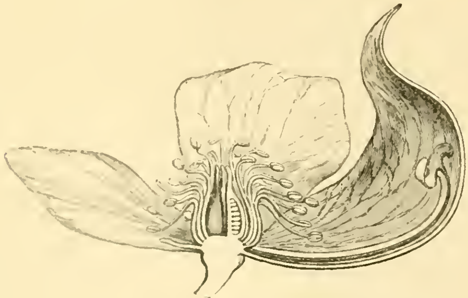
Aconitum Napellus.

FIG. 43. Flower.

FIG. 44. Flower, the sepals detached.

FIG. 45. Diagram.

Each has the form of a conical tube swollen at the tip, where it is lined by a glandular nectariferous tissue, the inner border forming a projecting lip, and the outer border supported by a long inflexed claw, whose margins are turned inwards to form a kind of gutter (fig. 46). The six other petals are reduced to short filaments, unequal and but slightly coloured. The stamens are very numerous, and inserted spirally as in *Nigella*, but the secondary spirals are not



Aconitum Napellus.

FIG. 46. Longitudinal section of flower.

FIG. 47. Fruit.

so marked. The filaments are dilated, and, as it were, petaloid

[1] PAYER, *Organog.*, 252, t. lv.

at the base, and taper at the tip to support a basifixed two-celled introrse anther, dehiscing by two longitudinal clefts.[1] The gynæceum consists of from three to five[2] free carpels, inserted on a spiral[3] near the apex of the receptacle, each composed of an ovary tapering above into an acute style, which is stigmatiferous only at the top and on the margins of the vertical groove, which runs the whole length of the inner angle of the carpel. The ovary contains two vertical rows of anatropous ovules, inserted along the inner angle. The fruit is usually formed of three follicles dehiscing along the inner angle (fig. 47) to set free the seeds, which have a spongy, more or less rugose surface, being covered by wrinkles and membranous projecting folds. The embryo is surrounded by the abundant fleshy albumen.

A. Napellus is a herbaceous plant with alternate palmatisect exstipulate leaves, and blue or white flowers in terminal racemes. Each flower is axillary to a bract which becomes smaller and less dissected as it is higher up on the principal axis. The top of the pedicel is slightly swollen, and at this point we notice, applied to the calyx itself, the two lateral sterile bracts which accompany the flower and have been carried up with it.

Aconitum Lycoctonum.
FIG. 48.
Flower.

We know about a score of other Aconites properly so called. But all these species have not sepals formed exactly as in *A. Napellus*.[4] Thus, *A. hebegynum* DC., and *A. variegatum* L., have the posterior sepal like a conical compressed helmet. *A. Anthora* L.[5] has this same sepal conical and semicircular, while in *A. Lycoctonum* L.,[6] it assumes the form of a true narrow elongated spur (fig. 48), obtuse only at the tip. But there is every possible transition between these

[1] Each cell when open forms, as in the Columbines, a plate spread out edgewise. The cleft being far more interior than exterior, this plate is attached to the connective, not at the middle of its breadth, but nearer the inner border.

[2] The number three is by far the commonest, though we see in gardens flowers with five, six, eight, and even more carpels.

[3] Which we must understand does not preclude the existence of secondary radiating rows analogous to those observed in *Nigella*.

[4] Sect. iv. *Napellus* DC., *Syst.*, i. 371, (incl. *Cammarum* [DC., *l. cit.*, 374, sect. iii.], *Corythæba* REICHB., *Enchylodes* REICHB., ex SPACH. *Suit. à Buff.*, vii. 367).

[5] Sect. i. *Anthora* DC., *Syst.*, i. 364, *Prodr.*, i. 56.

[6] Sect. ii., *Lycoctonum* DC., *Syst.*, i. 367, *Prodr.*, i. 57.

forms of sepal 2; so that no one has ever been able to ignore on this account the very close affinities which bind together the different species of Aconite; or has ever separated them from one another on seeing notable modifications presented by the characters of the gynæceum or corolla: the first having four or five carpels in *A. variegatum, hebegynum*, &c.; the latter losing its lateral and anterior petals; this occurs in *A. Lycoctonum* and the related species. The flowers of these last are usually yellowish, and more rarely wine red or dark purple.[1]

We see from all this that an Aconite may be defined as a *Nigella* with irregular flowers; and that the irregularity depends on the deformity of the posterior sepals, and the great inequality of the petals which become larger as they are nearer the axis—*i.e.*, the posterior side of the flower. Besides, the androceum and gynæceum are the same in their essential characters; and in the same way sepals 4 and 5 have only one petal opposite each of them, while sepals 1, 2, and 3 have each a pair of petals before them, at least in *A. Napellus* The same irregularity, more or less marked, is observed in the Larkspurs.

The genus *Delphinium*, or Larkspur,[2] includes a very large number of species, which do not all present exactly the same organization, and which it has been proposed on this account to split up into several genera.[3] The variations observed depend on the greater or lesser development of the parts of the corolla and the gynæceum. These parts, then, are more or less irregular in the different types which we shall review.

If we examine, for example, *D. peregrinum* LAMK.,[4] which grows in the south of France, we see that its calyx is composed of five sepals, of which the posterior one is prolonged into a spur analogous to that of *Aconitum Lycoctonum*. These sepals are further quincuncially imbricated in the bud (fig. 50) and within them we find a corolla of three petals opposite the three posterior sepals. While each lateral sepal has before it only one petal, the posterior sepal has

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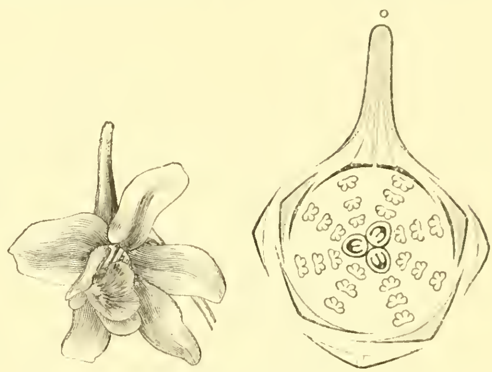
[1] *A. septentrionale* KŒLL., *Spic.*, 22, and *A. rubicundum* FISCH., ex SER., *l. cit.* 135, 136.

[2] *Delphinium* T., *Inst.*, 426, t. 241.—L., *Gen.*, n. 681.—JUSS., *Gen.*, n. 231.—SPACH, *Suit. à Buff.*, vii. 355.—ENDL., *Gen.*, n. 4796.—PAYER, *Organog.*, 249, t. lv.—B. H., *Gen.*, 9, n. 25.—H. BN., *Adansonia*, iv. 8, 11, 48, 149.

[3] I. *Delphinastrum* SPACH, *Suit. à Buff.*, vii. 336; II. *Phledinium* SPACH, *l. cit.*, 351 (*Consolida* LINDL., *Journ. Hortic. Soc.*, vi. 35); III. *Staphysagria* SPACH, *l. cit.*, 347; IV. *Aconitella* SPACH, *l. cit.*, 358.

[4] *Dict.*, ii. 264.—*D. cardiopetalum* DC., *Syst.*, i. 347.

two, each prolonged as a spur into its cavity. But it is easy to see that these two petals arise from the deduplication of a single one, and that its two parts are symmetrical with each other, and represent each the half of a single organ. In other words, the posterior petal behaves here like that of most *Nigellas*; and the corolla becomes irregular because, on the one hand, the petal is spurred like the corresponding sepal; and on the other hand, the anterior petals are not normally developed.



Delphinium peregrinum.
FIG. 49. Flower. FIG. 50. Diagram.

The structure of the corolla[1] is the same in certain other species cultivated in our gardens, such as *D. revolutum* DESF., *cheilanthum* FISCH., *dictyocarpum* DC., *grandiflorum* L., *triste* FISCH., &c., which have usually only three carpels in the gynæceum. *D. pentagynum* LAMK. derives its name from its possessing often five carpels with the same corolla. It is only by accident that we find the anterior petals in these plants; cultivation will sometimes determine their appearance,

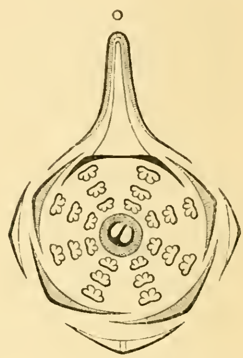
D. Consolida L. (figs. 51 and 52) and *Ajacis* L., have the corolla and gynæceum far more imperfect. The two lateral petals disappear as well as the anterior ones, only the posterior petal remaining, divided above alone into two half petals, but single near its insertion and for the whole length of the spur, while the gynæceum is reduced to a single carpel.

In all these species the androceum remains as in *Nigella*,[2] with

[1] On the organization of this corolla of the Larkspurs, and especially that of the posterior petal, see *Adansonia*, iv. 11.

[2] Hence it follows that when the flower of a *Delphinium* becomes double, and its stamens are transformed into petals, this flower is altogether that of a similarly transformed *Nigella*, especially when the spur disappears entirely (which is rare) or nearly so; the flowers are then double and regular in both types, which it is in this case impossible to distinguish (see *Adansonia* iv. 149). Instances of monstrosities in Larkspurs and Aconites are very numerous. See BRONGNIART, *Ann. Sc. Nat.*, sér. 3, ii. 24.—WEDDELL, *Sur une Chloranthie de Pied d' Alouette Vivace* (*Bull. Soc. Bot.*, iii. 346).—HOCHSTETTER, *Fl. Anorm. d'A.* tauricum (*Bull. Soc. Bot.*, ii. 120).—DUCHARTRE, *Monst. de* D. Ajacis (*Bull. Soc. Bot.*, vii. 483). CLOS, *Hyp. des Carp. d'un* Delphinium (*Bull. Soc. Bot.*, ix. 127) and others.—A. BRAUN (*Verh. d. sect. f. Bot.*, Vienna, Sept. 20, 1856) and J. ROSSMANN (*Bot. Zeit.*, 1862, n. 24, 188), have also each given their interpretation of the flower of *Delphinium*.

the stamens in curved rows, eight in number (fig. 52), each stamen with its filament dilated below, and its anther two-celled, introrse,



Delphinium Consolida.

Fig. 51.
Longitudinal section of flower.

Fig. 52.
Diagram.

with the cells spreading out into flat plates after dehiscence. In all the inflorescence consists of terminal racemes, each flower being solitary in the axil of a bract, and bearing two sterile bracts at a variable height on its pedicel. These species, characterized by their single carpel, constitute the genus *Phledinium* (*Consolida*).[1]

Delphinium Staphisagria.

Fig. 53.
Flower with four petals.

Fig. 54.
Flower with eight petals.

[1] Flowers sometimes occur with two or three carpels; but a higher number is tolerably rare, even in cultivated plants. However, Kirschleger (*Notic. Botan.*, 6) has seen flowers of *D. Ajacis* with from five to eight carpels. In our parterres, when the carpels are thus numerous, some of them may be sterile. In double flowers we further observe that the posterior petals (the two halves of a single organ) are either entirely separate or else united for nearly the whole length of the limb. This is then flat, and traversed by two large greenish ribs, which separate decidedly towards the tip, the petal becoming bidentate or bilobate. The spurs become smaller like that of the sepal which encloses them, but they are separate, each forming a distinct tube. As in *D. Consolida*, the spur very rarely disappears entirely in both calyx and corolla. The flower is then also the same as that of a double *Nigella*.

Stavesacre[1] (figs. 53–58) has nearly all the characters of the preceding plants; but the spur of the posterior sepal is relatively shorter and broader, and slightly bifid at the tip. The petal opposite this is sessile, and is prolonged downwards and into the spur to form a thick hollow glandular double spur (fig. 55), while its limb is deeply divided into two erect halves, nearly symmetrical with one another, and united in front by a short cross-piece, so that the division of this organ into two half petals is not quite complete. The lateral petals are represented by little wings of two kinds; while the anterior petals are quite wanting in some flowers (fig. 53) and exist in others,[2] which have then eight petals arranged like those of *Aconitum Napellus*, four of them being in pairs opposed to sepals 1 and 3 (fig. 56).

The androceum is that of the preceding plants (figs. 55 and 56) and the gynæceum is usually formed of three carpels,[3] of which one is nearly posterior. The follicles are thick, and each encloses seeds closely pressed together, so as to be more or less deformed. The copious albumen contains the minute embryo near its apex; and the

Delphinium Staphisagria.

FIG. 55. Flower without its calyx.

FIG. 56. Diagram.

[1] *D. Staphisagria* L., *Spec.*, 750. *S. macrocarpa* SPACH, *l. cit.*

[2] On the same plant we may find flowers with eight petals, and others with less. When there are eight we see, as in the Aconites, a single one opposite sepal 4 and sepal 5, and a pair opposite sepal 1, sepal 2, and sepal 3. The two petals which are opposite sepals 4 and 5 form at the base a sort of flattened spur, glandular and nectariferous within. The anterior petals, when present, are reduced to small flattened unequal scales, the anterior one of each pair remaining much less developed than the other. See BRONGNIART, *Ann. Sc. Nat.*, sér. 3, v. 300, and PAYER, *loc. cit.*, 261, note.

[3] From two to four carpels may be counted, rarely more. Their position has not yet been accurately decided (see *Adansonia* iv. 21), any more than in most sections of this genus. The ovules of Stavesacre are few in number, and in the typical species there are only four in two vertical rows. They are placed back to back, and are somewhat ascending.

external integument is unequally thickened, so that its surface presents a mesh of anastomosing ridges (figs. 57 and 58). Stavesacre is usually a biennial.

Delphinium Staphisagria.
Fig. 57. Seed. Fig. 58. Longitudinal section of same.

There is, then, no essential difference between *Delphinium* and *Aconitum.* It is true that the form of one sepal and of the petals differs usually.[1] The large posterior petals of an Aconite have a hood-like limb on a long claw, while the Larkspurs have the limb sessile, or nearly so, and cornet-shaped. The lateral petals, when present, are membranous and flattened in the Larkspurs, while they are represented by short linear rods in the Aconites. But these are differences of form which do not affect the general structure of the flower. It is further true that the posterior sepal is broad, shallow, and helmet-shaped in *A. Napellus,* while it is much narrower and more elongated in *Delphinium,* where we call it a spur. But this same sepal becomes very long and narrow in Aconites like *Lycoctonum,* while the anterior sepals at the same time disappear, as in most Larkspurs. The floral symmetry, the gynæceum, the fruit, the seeds, the inflorescence, and the habit are the same in both types; and hence we have proposed,[2] and still propose, to unite them into one genus under the name of *Delphinium.*[3]

All these plants have, too, except in a few particular cases,[4] the

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[1] And we must even add that this difference of form disappears entirely in the Larkspurs which Spach (*l. cit.*) has separated under the name of *Aconitella.* In this small group the spur of the posterior sepal has exactly the same conformation as that of *Aconitum Lycoctonum,* and the allied species. Sometimes the petal opposite this posterior sepal has itself an acute spur, as in *D. flavum* DC.; or, as in *D. Aconiti* L. and *anthoroides* Boiss, the spur may be twisted into a long spiral towards its extremity as in *A. Lycoctonum.* Besides, we must remark that in all these plants there is only a single carpel as in *D. Consolida,* and *Ajacis,* and that the posterior sepal sometimes does not present in limb or claw the least sign of deduplication. On the other hand, certain large flowered Larkspurs from India have exactly the habit of certain Aconites, and it is impossible to see why the rounded and somewhat concave posterior sepal deserves the name of spur, rather than hood. As for the foliage, which is not exactly the same in our common species of Aconite and Larkspur, to show how unimportant a character that is, it will suffice to recal to mind the existence of *A. delphinifolium* (Ser., *l. cit.*, 159).

[2] *Adansonia* iv. 12, 48.

[3] *Delphinium* Sections 5.
1. *Eudelphinium.* (*Delphinastrum, Delphinellum.*)
2. *Consolida* (*Phledinium, Aconitella.*)
3. *Staphisagria.*
4. *Lycoctonum.*
5. *Aconitum.* (*Napellus, Cammarum, Anthora.*)

[4] Certain species are annuals. Others have sarmentose slender stems, and alternate leaves distant from one another, on a level with which the flowers are grouped into short racemes. Such are *A. volubile* Pall., and the Chinese climber with palmiveined three-lobed leaves which may be called *D.* (*A.*) *humulinum.*

same plan of growth as *Aconitum Napellus*; that is, they have a tap-root at first surmounted by a single stem, giving off from the axils of its leaves branches, which are, like itself, terminated by an inflorescence. Afterwards, when the aerial part of the plant has thus accomplished its evolution it is destroyed, and the plant branches at the base of the stem, developing successively, from above downwards, the buds axillary to the lowest leaves or scales of the ascending axis. Each of these secondary axes behaves the same way in the end, and also ramifies at the base, while the main tap-root, more or less hypertrophied and succulent, or else grown woody, gradually becomes hollow in the centre, and persists for a variable number of years at the base of the subterranean part of the plant.[1] The flowers are grouped in simple or compound racemes, each being axillary to a bract or leaf but little modified, with two lateral sterile bracts at a variable height on each pedicel. In some species, as *D. axilliflorum* DC., the inflorescence simulates a spike, owing to the shortness of the pedicels; the flower being, however, still accompanied by two lateral bracteolæ, sometimes simple, sometimes compound like the leaves. These are constantly alternate and exstipulate, with the blade entire, but slightly lobed, palmatifid, or dissected.[2]

The species, about sixty in number, chiefly inhabit the colder, and especially the temperate zones of the northern hemisphere in both Worlds.[3]

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[1] This is on the whole the mode of vegetation of many perennial Ranunculads with successive terminated axes. In most of the cultivated perennial Larkspurs and Aconites (e.g., *D. formosum* and its varieties), after removing the numerous adventitious roots that the subterranean portion produces annually, we see at the base of the flowering stem a swelling which bears small, half-withered leaves, arranged in an evident spiral, and rows of axillary buds (also spirally arranged), which are smaller as they are lower down. The somewhat tumid bases of the second generation of axes bear in the same spiral order axillary buds, which become axes of a third generation, and so on. This recurrence in the evolution of buds is very general in *Ranunculaceæ*. In the annual species their evolution is early arrested, or is accomplished in a single season.

[2] Some species have the leaves dissimilar to one another (*A. heterophyllum*, WALL.).

[3] SERINGE, *Esq. d'une Mon. du g.* Aconitum (*in Mus. Helvet.*, i. (1822,) 115, t. 15.)—REICHB., *Icon.*, iv. t. 66-100; *Ill. spec.* Aconiti (1823-27); *Mon. gen.* Aconiti, Leips. (1820.)—KOCH, *Ann. Sc. Nat.*, sér. 2, iii. 371.—GREN. & GODR., *Fl. Fr.*, i. 44, 45.—REGEL, *Consp. gen.* Aconiti *Flor. Ross.* (*Ann. Sc. Nat.*, sér. 4, xvi. 144).—HOOK. & TH., *Fl. Ind.*, i. 47, 54.—BOISS, *Diagn. Pl. Orient.*—A. GRAY, *Ill.*, t. 15, 16.—WALP., *Rep.*, i. 51, 57; ii. 743, 745; v. 6, 7; *Ann.*, i. 13, 14; ii. 12, 13; iv. 22, 23.

II. RANUNCULUS SERIES.

If we analyse the flower of one of our indigenous *Ranunculi*,[1] known under the vulgar names of Crowfoot, Spearwort, Kingcups, Buttercups, &c. (Fr. *Bassinets, Grenouillettes, Boutons d'or, d'argent*, &c.), for example, the Great Spearwort (*Ranunculus Lingua* L., Fr. *Grande Douve*) (fig. 59), we find that it is regular and hermaphrodite, with a slightly convex receptacle. The calyx is formed of five free, somewhat unequal, sepals, which are the more membranous and coloured as they are the more internal in the bud, where they are quincuncially imbricated (fig. 60). They are caducous, as are also the five petals which alternate with them, and which are also free and imbricated in æstivation.[2] The claw, which is almost obsolete, is surmounted by a glandular depression on the inner surface of the limb. Above the perianth, the receptacle is produced into a short cone, very regular in some species, as *R. repens* L. (figs. 61, 62), and supports an indefinite number first of stamens and then of carpels, inserted in a spiral.[3] The stamens are free, and each is composed of a

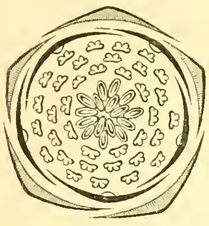
Ranunculus Lingua.
FIG. 59.

[1] *Ranunculus* HALLER, *Helvet.*, ii. 68.—T., *Inst.*, 285, t. 149.—L., *Gen.*, n. 699.—JUSS., *Gen.*, n. 233.—DC., *Prodr.*, i. 26.—SPACH, *Suit. à Buff.*, vii. 203.—ENDL., *Gen.*, n. 4783. —PAYER, *Organog.*, 255, t. lvii.—B. H., *Gen.*, 5, 6, n. 9–12.—H. BN., *Adansonia*, iv. 50.

[2] The imbrication of the five petals is variable, being sometimes quincuncial like that of the calyx, while often there is but one petal that is wholly outside, and only one entirely covered in.

[3] According to PAYER (*Bull. Soc. Philom.*, May 17, 1845, 59), the fraction indicating the spiral arrangement of the petals and stamens is $\frac{8}{21}$.

filament expanding above into an erect basifixed connective, which supports the two adnate vertical cells of an extrorse anther



R. Lingua.
FIG. 60.
Diagram.

Ranunculus repens.

FIG. 61.
Flower.

FIG. 62.
Longitudinal section of flower.

dehiscing by two longitudinal clefts.[1] The carpels are each composed of a transversely compressed ovary tapering into a beaked style, recurved outwards. Along the whole length of the inner angle runs a vertical groove, whose margins, thickened and somewhat everted, are covered above with stigmatic papillæ. In the inner angle, at a variable distance from the base of the single-celled ovary, is inserted an ascending ovule, whose micropyle looks outwards and downwards.[2] After flowering, the perianth and androceum usually fall and discover a multiple fruit, formed of a variable number of achenes, each of which encloses a seed containing a minute embryo towards the apex of abundant fleshy albumen. The surface of the achene is sometimes smooth and sometimes covered with ribs, wrinkles, or even well-developed prickles, as occurs in *R. arvensis* (figs. 63, 64), *muricatus, Philonotis,* and a certain number of allied species.[3] The form and height of the beak or persistent style which

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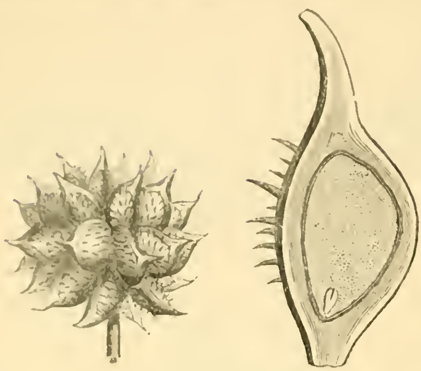
[1] The lines of dehiscence are very decidedly exterior in *R. Seguieri,* and the anther is certainly extrorse, though less markedly so, in *R. Lingua, Flammula, acris, arvensis, angulatus, gramineus, parviflorus,* &c.; the dehiscence is exactly lateral in *R. platanifolius* and *aconitifolius. R. sceleratus* and *aquatilis* are intermediate between these two groups, their dehiscence being but slightly extrorse; but in no case is it introrse.

[2] The ovule is always inserted into the inner angle of the carpel, near its organic base. Hence the ovule becomes horizontal, or even slightly drooping, whenever the ovary is much developed in its dorsal and posterior part. Here, as everywhere else, a drooping ovule with the raphe dorsal corresponds to an ascending ovule with the raphe ventral. Moreover, as BENTHAM & HOOKER (*Gen.,* 6) remark, on the subject of *Cyrtorhyncha* NUTTALL (TORR. & GR., *Fl. N. Am.,* i. 26.—ENDL., *Gen.,* n. 4771), which they refer to the genus *Ranunculus,* an ovule which is absolutely drooping in space, is really ascending in relation to a carpel which, pressed on by its neighbours, has its tip turned first outwards and then downwards.

[3] In grouping the genus *Ranunculus* into sections, some use has been made of the nature of the surface of the carpels. Thus DE CANDOLLE distinguishes *Ranunculastrum* (sect. ii. *Prodr.,* i. 27), *Thora* (sect. iii. 30), and *Hecatonia* (sect. iv. 30), by their smooth carpels, while his *Batrachium* (sect. i. 26), admitted as a distinct genus by several authors (SPACH, *Suit. à Buff.,* vii. 199), has the pericarp transversely striated and rugose, and his *Echinella* (sect. v. 41.—*Gen. Pachyloma* SPACH, *Suit. à Buff.,* vii. 191.—*Philonotis* REICHB., *Consp.,* 191) has the carpels covered

surmounts the carpels, also vary much.[1] The *Ranunculi* are herbs with alternate leaves which may be simple or compound, complete or incomplete;[2] their flowers are solitary or in terminal cymes.[3]



Ranunculus arvensis.

Fig. 63. Complete fruit. Fig. 64. Carpel opened.

There are *Ranunculi* in which the petals disappear almost entirely, being only represented by minute scales, glandular at the base, identical with the organs which in other families we have above termed nectaries.[4] In some, indeed, the petals disappear entirely, and these have been erected into a quite

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with prickles or projecting tubercles. If we examine the origin of these carpels in *Ranunculus arvensis*, *trilobus*, *Philonotis*, &c., we see that they depend only on the outer layers of the pericarp, that they do not develope till late, that they differ in number and size in different carpels of the same species, and that hence their importance can only be slight. Cambassedes has already remarked (*Flor. Balear.*, 32) that the number of tubercles did not give an absolute distinction between *Ranunculus Philonotis* and *trilobus*.

[1] For this reason Bentham & Hooker have not admitted the genera *Xiphocoma* and *Gampsoceras* Stev. (*Bull. Mosc.*, 1852, t. 7), or *Cyprianthus* Spach, (*Suit. à Buff.*, vii. 220), established for *R. Orientalis* L. *R. Cornutus* is remarkable for the small number of carpels; some flowers have only three or four.

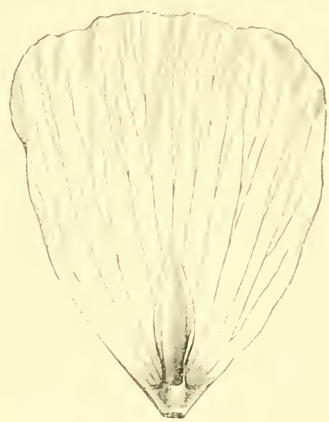
[2] In *R. Lingua* (fig. 59), *Flammula*, *gramineus*, *alismoides*, &c., we have simple leaves dilated at the base into an imperfect sheath, the blade entire or nearly so, and narrow and elongated, recalling that of a Monocotyledon. In our commonest *Ranunculi* the leaves have a distinct blade more or less lobed, or even divided into distinct leaflets. *R. sceleratus* offers every transition between simple, even entire, leaves, and those most dissected. *R. Thora* has on its peduncle two special leaves differing from one another and from the cauline leaves. Finally, in the section *Batrachium* there have always been remarked leaves provided with basilar membranous stipuliform expansions, varying much according as they are aerial or entirely submerged, when they are reduced to capillary ramified thongs. (See Gren. & Godr., *Flor. Fr.*, i. 18, t. A.)

[3] Some *Ranunculi* have solitary terminal flowers. In others the leaves or bracts below the flower bear in their axils younger flowers, the number of these floral generations varying with the species. In *R. Thora*, which has often two flowers, these form a uniparous cyme, the lateral flower being the younger. In our commonest terrestrial *Ranunculi* the cymes thus formed are always uniparous and many flowered. So, too, because the flower always terminates the axis, we get leaf-opposed flowers in certain species, as in *R. Flammula* (see, also, on this subject Guillard, *Bull. Soc. Bot. Fr.*, iv. 32, 36, 121).

[4] The petals become very small and even disappear in certain flowers of some of our common *Ranunculi*, as *R. Auricomus* (Rochebrune, *Bull. Soc. Bot. Fr.*, ix. 280). In *R. apiifolius* Poir., which has to A. St. Hilaire become the type of a separate genus, under the name of *Aphanostemma* (*Flor. Bras. Merid.*, i. 12.—Endl., *Gen.*, n. 4781), the sepals are petaloid, but on the other hand the petals are quite small and reduced to little rods, each with a glandular head cup-shaped at the summit. The remaining characters are those of other *Ranunculi*. The indefinite stamens have basifixed extrorse anthers, and each of the numerous carpels contains an ascending ovule with the micropyle downwards and inwards. The bracts near the flowers are provided at the base with lateral membranous stipuliform expansions. Following Bentham & Hooker (*Gen.*, 6), we only make *Aphanostemma* a section of the genus *Ranunculus*.

distinct genus under the name of *Trautvetteria*.[1] But we cannot logically preserve this genus, as we have not made one for the apetalous species of *Isopyrum*.

There are, on the other hand, *Ranunculi* whose petals assume a great development, and where the glandular pit at the base is provided internally with a more or less projecting scale of varying form,[2] or is itself prolonged at its outer border to form a nectariferous, more or less prominent tube (fig. 65). In other species there is a strong tendency to increase in the number of petals. Sometimes one or more of them are deduplicated, the corolla still forming a single verticil. Again, the spiral line along which the petals are inserted may be prolonged so as to produce a second corolla[3] within the other, whose elements may also undergo deduplication. Thus,



Ranunculus amplexicaulis.
FIG. 65.
Petal.

[1] *Trautvetteria palmata* FISCH. & MEY. (*Ind. Sem.* (1835), 22); *Anim. Bot.* (*Ann. Sc. Nat.*, sér. 2, iv. 335); *Cimicifuga palmata* MICHX (*Fl. Am. Bor.*, i. 316).—*Actæa palmata* DC., *Prodr.*, i. 64, which we consider an apetalous *Ranunculus*, is a perennial growing in Japan and North America. Its palmatifid leaves recal strongly those of *R. aconitifolius* and the allied species; and its numerous flowers, whose cymes are united into a kind of panicle at the top of a long peduncle, give it nearly the aspect of certain white-flowered *Ranunculi* (Fr. *Boutons d'argent*), or several species of *Actæa* and *Thalictrum*. But its fruit and seeds are quite those of a *Ranunculus*. Its five sepals are quincuncially imbricated in the bud. The very numerous stamens are the shorter as they are the more exterior. The filament is folded in the bud, but at the expansion of the flower becomes much exserted; it is dilated somewhat below the attachment of a basifixed anther, which dehisces laterally or somewhat externally. The very numerous carpels are arranged spirally on the superior dilated part of the receptacle; each tapers above into a recurved style.

[2] The characters presented by the nectariferous pit and its prolongations, or the sort of scales which accompany it, have served to establish several sections in the genus *Ranunculus*. In *Batrachium* the pit is surmounted by what is termed an *aglet*, that is, as in fig. 65, it is the exterior border which is prolonged into a more or less concave, elongated, spoon-like body. In *Euranunculus* GREN. & GODR. (*Fl. Fr.*, i. 19), there is on the other hand a more or less marked projection of variable form occupying the inner border of the depression; we then say that the pit is lined with a *scale*. Finally in *R. sceleratus* L. (*Spec.*, 776,) by several authors made the type of a special genus under the name of *Hecatonia palustris* (LOUREIRO, *Fl. Cochin-Chin.*, 371. — SPACH, *Suit. à Buff.*, vii. 198), the petal has neither aglet nor scale. The claw is short, and above it, on the inner surface of the limb, is an oval nectariferous pit with a small upturned extremity. This pit is bounded by a projecting rim, wanting at the upper extremity, so as to resemble a horse-shoe, with the concavity upwards. ADANSON was the first to make a curious comparison between the nectariferous depressions of the *Ranunculi* and the nectaries of the Hellebores, &c.

[3] Or it may be that the outer stamens become petaloid; which comes to the same thing, since after the facts established by PAYER the pieces of the corolla and androecium are here on one continuous spiral. Hence when the transformation goes further we have the numerous species with double flowers, of which so many examples have been quoted since the time of

besides the case of double flowers which are frequent in *Ranunculus*, we may find corollas which normally possess a score of petals. We may note *R. fluitans* LAMK., *millefoliatus* VAHL., *salsuginosus* PALL., *cymbalariæ* PURSH, *præmorsus* H. B. K., *sibbaldioides* H. B. K., *chilensis* DC., *filamentosus* WEDD., &c.

The form of the floral receptacle is itself very variable in the genus *Ranunculus*. Thus, in *R. sceleratus* (figs. 66, 67) this recep-

Ranunculus sceleratus.

FIG. 66.
Flower.

FIG. 67.
Longitudinal section of flower.

tacle, after bearing but a small number of short stamens, swells into a nearly globular head covered with numerous carpels. On the other hand, the receptacle may elongate above the stamens so as to resemble at a distance the cylindro-conoidal form of that of *Myosurus*. *Ceratocephalus*, which cannot be generically separated from the *Ranunculi*, gives a manifest example of this. This name MŒNCH[1] has given to a species[2] of Ranunculus characterized only by this form of the axis, by its somewhat fewer stamens, and by the lateral projections on its carpels.[3]

TOURNEFORT (*Inst.*, 285-293) especially by DE CANDOLLE (*Mém. de la Soc. d'Arcueil*, iii. 385). Nothing is more frequent than *Ranunculi* with monstrous flowers. (See also *Bull. Soc. Bot. Fr.*, v. 296; viii. 348; ix. 280, and *Adansonia*, iv. 156, &c. &c.)

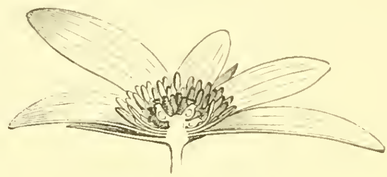
[1] *Ceratocephalus*, MŒNCH, *Méth.*, 218.—*C. falcatus* PERS., *Ench.*, i. 341.—DC., *Prodr.*, i. 26.—ENDL., *Gen.*, n. 4784.—*Cratæogonum hispanicum* BARR., *Icon.*, 376, 2.—*Ranunculus Ceratophyllus* MOR., *Hist. Oxon.*, ii. 440, ex T., *Inst.*, 289.—*R. falcatus* L., *Spec.*, 781.—JACQ., *Fl. Austr.*, t. 48.

[2] Since then, botanists have distinguished seven or eight species—perhaps only various forms of a single one. The numerous carpels have a bent or straight style. It has the latter direction in *R. testiculatus* BIEB., of which DE CANDOLLE (*Syst.*, i. 231; *Prodr.*, i. 26, n. 2; *Icon. Deless.*, vi. t. xxiii.) has made his species *C. orthoceras*.

[3] The ovary of *Ceratocephalus* contains but one ascending ovule with a single coat, like that of a *Ranunculus*. Some have taken as a generic characteristic the existence of these bigibbous carpels with two empty cells at the base (GREN. & GODR., *Fl. Fr.*, i. 18). If we seek for the origin of these two lateral horns at the base of the fruit, we see that they are owing to a separation of the pericarp into two layers, and to the increased growth of the outer layer. Hence arises within the thickness of each projection a cavity recalling that observed in the pericarp of *Nigella damascæna*. But the seed remains quite shut in by the endocarp; it has two very thin coats and abundant albumen.

Casalea[1] is the name given to some American *Ranunculi* in which the number of pieces of the perianth may be reduced to three in each whorl. But this reduction is not constant,[2] and besides, all the other characters are those of *Ranunculus*, so that we can hardly erect *Casalea* into a separate section.

Ranunculus Ficaria L. (fig. 68) has been equally considered as the type of a distinct genus,[3] because its flowers are trimerous, and its corolla is double, the pieces of the inner whorl being altogether or in part deduplicated.[4] But these characters, which may have formerly appeared sufficient to constitute a genus,[5] are remarked, the one in *Casalea*, and the other in the *Ranunculi* strictly so called mentioned above, without our being able now-a-days to give them a generic value.



Ranunculus Ficaria.
FIG. 68.
Longitudinal section of flower.

We have stronger reasons for not separating *Oxygraphis*[6] generically from the *Ranunculi*, for if we observe the same multiplication of organs in its corolla, yet the flower is still on a quinary type, and we cannot attribute much importance to the usual persistence of one part of the perianth.

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[1] *Casalea* A. S. H., *Flor. Bras. Mer.*, i. 6, t. 1. —ENDL., *Gen.*, n. 4782.

[2] Messrs. TRIANA & PLANCHON (*Ann. Sc. Nat.*, sér. 4, xvii. 12, note) already recognised the variability of this character.

[3] *Ficaria* DILL., *Nov. Gen.*, 108, t. 5.—DC. *Prodr.*, i. 44.—SPACH, *Suit. à Buff.*, vii. 196.—ENDL., *Gen.*, n. 4785. — *F. ranunculoides* MŒNCH, *Méth.*, 215.—*Ranunculus Ficaria* L., *Spec.*, 774.—CLOS, *Ann. Sc. Nat.*, sér. 3, xvii. 129. The whole of this work, which is of quite a special character, should be read.

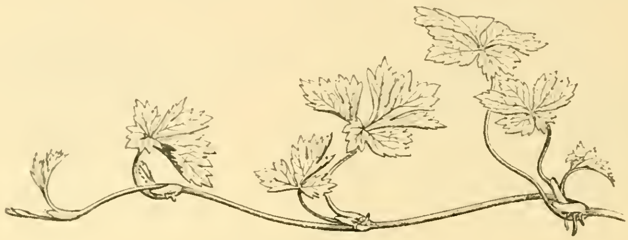
[4] M. CLOS (*l. cit.*, 138) counts from five to eleven. Usually there are three petals in the outer corolla, and the inner petals are in three alternating groups, one of three, one of two, and the third of a single piece. (See PAYER, *Organog.*, 254.—H. BN., *Adansonia*, ii. 202.)

[5] DILLEN established the genus especially on account of the trimerous character of the corolla. ADANSON preserved it, says M. CLOS (*l. cit.*, 140) under the name of *Scotanum* (CÆSALP. ex ADANS., *Fam.* 459), borrowed from BRUNFELS. PAYER and ourselves maintained it (*l. cit.*, 210) on account of its trimerous type, the deduplication of the corolla, and the position of the sepals with regard to the axis. The facts we have since observed in *Casalea*, the Pæonies, &c., have necessarily modified our original view.

[6] *Oxygraphis* BUNGE, *Fl. Altaic.*, suppl., 46. —ENDL., *Gen.*, n. 4785[1], suppl., i. 1419.—HOOK. & TH., *Fl. Ind.*, i. 27.—WALP., *Ann.*, iv. 31.—B. H., *Gen.*, 6, n. 12. In the flowers of *O. glacialis* BGE. (*Ficaria glacialis* FISCH.), there are five sepals in a quincunx and often ten petals forming a corolla of two alternating whorls, and bearing a thickening in which is a glandular depression at their base. The stamens are indefinite with extrorse anthers; the carpels each enclose a single ascending ovule with the micropyle external. In *O. polypetala* HOOK. & TH. (*Ranunculus polypetalus* ROYLE, *Ill.*, t. xi. fig. 2. —*Callianthemum Endlicheri* WALP.) the flowers are similar, but have from fifteen to twenty petals, each of the inner ones being replaced by a group of two, three, or four. Hence we may consider the Oxygraphids as *Ficariæ*, whose flowers are formed on a quinary type; and just as we cannot separate the two above-mentioned species of *Oxygraphis* generically from one another, so we cannot remove them from the *Ranunculi*. (See CLOS, *Ann. Sc. Nat.*, sér. 3, xiii. 141.)

Nearly all the *Ranunculi* have hermaphrodite flowers. They are nevertheless accidentally polygamous in some; and diœcia is nearly constant in some American species native in the regions near the Antarctic Pole, which have been designated *Hamadryas*;[1] we only admit them as a section.[2]

The *Ranunculi* are a numerous family; some have described three hundred species; their number may probably be reduced by one-



Ranunculus repens.
FIG. 69.
Stem.

half. We find them all over the world from one pole to the other—common in the temperate[3] and cold[4] regions of both hemispheres, much rarer in the warm countries.[5] Many are annuals, and sometimes are of very short duration.[6] Some are aquatic plants with the leaves submerged, at least in great part. The perennials only survive by developing in some of their organs (always near the young shoots) reservoirs of nutritive juice, of varying situation, but possessing always the same function—that of nourishing the young plants, whether they remain in connexion with the parent stock or become

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[1] *Hamadryas* COMM., herb., ex JUSS., *Gen.*, 232.—DC., *Prodr.*, i. 25.—SPACH, *Suit. à Buff.*, vii.—ENDL., *Gen.*, n. 4776.—WALP., *Ann.*, i. 7.—HOOK. F., *Fl. Ant.*, ii. 227, t. 85—H. BN., *Adansonia*, iv. 51.

[2] In the female flowers of *H. magellanica*, the carpels are indefinite, each surmounted by a small hooked style, and containing an ascending ovule with the micropyle external. In the male flowers are numerous unequal stamens, with basifixed anthers dehiscing by lateral clefts. The calyx consists of five sepals, entire, or deeply divided into two or more lobes. The petals are numerous, as in Oxygraphis, but are long and narrow with a contracted claw, at the summit of which is a glandular pit. The habit of this plant is that of certain *Ranunculi*, especially *R. Thapsia*. We cannot separate these plants from the *Ranunculi* on account of their diclinism, for that is observed in *Clematis*, *Thalictrum*, *Actæa*, &c.; nor for their numerous petals, which may be as many in the Ranunculi strictly so called.

[3] GREN. & GODR., *Fl. Fr.*, i. 18.—REICHB., *Icon.*, iii. 1-23.—WALP., *Rep.*, i. 33; ii. 738; v. 4; *Ann.*, i. 8, 954; ii. 6; iv. 6.—FISCH., *Anim. Bot.* (*Ann. Sc. Nat.*, sér. 2, iv. 332, 335).—STEV., *Ann. Sc. Nat.*, sér. 3, xii. 368.—S. & ZUCC., *Fl. Jap. Fam.*, 71.—A. GRAY, *Ill.*, t. 9.—WEDD., *Chlor. And.*, ii. 300.—TRI. & PL., *Fl. N.-Granat.* (*Ann. Sc. Nat.*, sér. 4, xvii. 11.)

[4] HOOK., *Fl. Antarct.*, i. 3, t. 1, 2; ii. 223, t. 81-83.

[5] HOOK. & TH., *Fl. Ind.*, i. 28.—A. S. H., *Fl. Bras. Mer.*, i. 6.—MART., *Fl. Bras.*, Renonc., 154.

[6] Especially *Ceratocephalus* (p. 36).

detached. In some species with prostrate stems, such *R. repens* (fig. 69), adventitious roots are developed at the base of the buds borne by these *runners;* and it is on a level with these roots that the base of the bud swells into a reservoir of nutritive juices. In other species the subterranean organs are developed much in the same way as the roots (Fr. *pattes*) of the *Anemones.*[1] Others, again, have the bases of the stem and the branches swollen into bulbs as in *R. bulbosus*,[2] which takes its name from this peculiarity. In the *Ficariæ* it is the buds axillary to certain aerial leaves which swell at the base, and are afterwards detached like bulbels.[3] Finally, in other species, like *R. asiaticus*

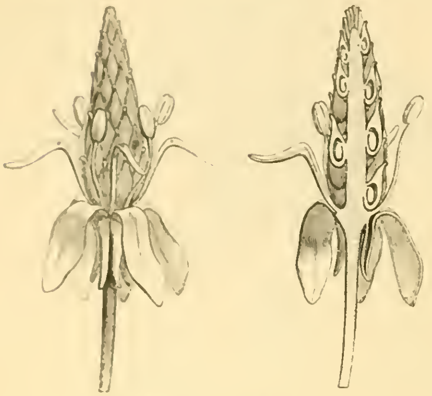
Ranunculus asiaticus.
FIG. 70.
Rootstock.

[1] In *R. acris*, for example, the principal axis ends in a flower, as do its ramifications. Quite at the base of this stem are leaves which are destroyed early, and which have buds in their axils. These buds in turn develope aerial branches which are to bear later on, in the axils of their lower leaves, the third generation of axes. Thus the base of the stem ramifies and becomes a rhizome like that of an Anemone, possessing none but adventitious roots. It is in the basilar portion of each bud, before the time for its elongation, that the nutritive juices accumulate, which are afterwards to aid in its development. The basilar portions of the divisions of the rhizome are more or less woody and dry, and they may even separate from the mother stock by destruction of tissue, so as to form new individuals beside it.

[2] In these species we only have an exaggeration of the phenomenon of the accumulation of nutritive juices in the base of the stem, and then in the base of the branches axillary to the lower leaves. If then we consider this swelling as a bulb, it belongs to the category of solid bulbs. CLOS attributes this swelling to the collar (*Ann. Sc. Nat.*, sér. 3, xiii. 1). GRENIER (*Bull. Soc. Bot. Fr.*, ii. 369, 721), whose opinion we have said (*Adansonia*, iv. 33, note), should be wholly adopted, refers it to the base of the stem.

[3] In *Ficaria*, of which the different modes of vegetation and the discussions to which their interpretation has given rise, have been reported by CLOS in the work above referred to (*Ann. Sc. Nat.*, sér. 3, xiii. 131), these axillary buds become bulbels, the tumid portion of which answers to the equally swollen succulent base of the subterranean buds of other Ranunculi. Most botanists are at variance as to the true nature of these swellings. What has proved to us that they are of the nature of axes is that they may possess two buds instead of one, and that in other cases they may bear a normal leaf with a bud in its axil. When these buds are detached from the mother plant, like those of other species, they are nourished by adventitious roots. IRMISCH has shown that we should not confound these bulbels with tumid axillary roots. BELHOMME has described (*Bull. Soc. Bot. Fr.*, ix. 241) in *R. Lingua* a fact quite analogous to what is seen in *Ficaria*. He says that the axillary buds of the submerged part of the

(fig. 70), the chief reservoir of juice is formed by the adventitious roots, whose cortical portion becomes thick and fleshy, emptying itself later on to supply materials for the development of the buds situated a little above the roots near the collar of the plant.[1]



Myosurus minimus.
FIG. 71. Flower. FIG. 72. Longitudinal section.

Close to *Ranunculus* comes the genus *Myosurus*[2] (figs. 71, 72), which differs from it in but very few characters.[3] The most marked is the great elongation of the receptacle, which resembles a small cylindro-conoidal branch, bearing successively one above the other, the perianth, the androceum, and the gynæceum, whose pieces are spirally inserted.[4] The calyx consists of from five to six sessile, free sepals, imbricated in the bud, and having the base produced beyond the point of insertion into a little tongue-shaped spur closely applied to the peduncle. The petals nearly equal in number to the sepals, and alternating with them, have a quite peculiar form (fig. 73). A very narrow claw supports a limb hollowed out to form a glandular cavity, which has its border much prolonged (but only externally) like the bowl of a spoon. The stamens are few in number, and the basifixed anther has two adnate extrorse cells

Myosurus minimus.
FIG. 73. Petal.

stems may be detached in winter, and put forth adventitious roots in the spring, so as to form as many distinct plants. (See further on the vegetation of *Ficaria*, the researches of GERMAIN DE SAINT-PIERRE, *Bull. Soc. Phil.*, Jan. 1862, and *Bull. Soc. Bot. Fr.*, iii. 11.)

[1] In *R. orientalis* (Genus *Cypriante* SPACH, *Suit. à Buff.*, vii. 220), the tuber contains the nutritive matter in the cortical portion of its adventitious roots. We have described (*Adansonia*, iv. 32) this tuber as analogous to the subterranean portion of *Dahlia*, with a small central axis bearing above a crown of buds, and lower down conical adventitious roots fleshy on the outside.

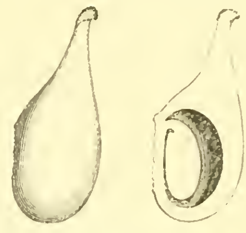
We think it right to again call the attention of the reader to the utility of consulting all that IRMISCH has written on the organs of vegetation of the *Ranunculaceæ* in general, and the *Ranunculi* in particular. (See note 3, p. 44.)

[2] *Myosurus* DILL., *Nov. Gen.*, 106. — T., *Inst.*, 293.—L., *Gen.*, n. 394.—JUSS., *Gen.*, 233. —DC., *Prodr.*, i. 25.—SPACH, *Suit. à Buff.*, vii. 192.—ENDL., *Gen.*, n. 4780.—B. H., *Gen.*, 5, n. 8.

[3] So that several authors have called the typical species of this genus *Ranunculus minimus* (AFZ., *Liljelb. Sv. Fl.*, 230, ex DC., *l. cit.*).

[4] According to PAYER (*Bull. Soc. Philomat.*, May 17, 1845, 59), the arrangement of the floral appendices is represented by the fraction $\frac{8}{21}$ as in the *Ranunculi*; hence the variable number of stamens, and their constant position with regard to the sepals.

dehiscing longitudinally by two nearly lateral clefts. The carpels, numerous and independent, have each a unilocular ovary tapering above into a little horn, covered at the tip with stigmatic papillæ. In the inner angle of the ovary is a solitary pendulous ovule, whose micropyle looks inwards and upwards (figs. 74, 75). During anthesis and after fecundation the receptacle continues to grow in length and thickness, and finally remains covered with numerous achenes, each containing a pendulous seed. *M. minimus* L., a very common plant in our country, is a small herbaceous annual, bearing a certain number of alternate simple leaves on a short stem[1] ending in a floral peduncle. Later other flowers are developed below the terminal one in the axils of the upper leaves. Another species is distinguished from that of our country by the absence or the slight development of the corolla.[2] This is not constant, and is of no more importance here than in *Ranunculus*. We may therefore define the genus *Myosurus* as *Ranunculus* with an elongated receptacle and descending ovules. They are small annual plants, of which only two species exist; one a native of Western America and New Zealand; the other spread over the cold and temperate regions of nearly the whole world.[3]



Myosurus minimus.
FIG. 74. Carpel. FIG. 75. Longitudinal section.

The *Anemones*,[4] too, are also plants closely related in their floral organization to the *Ranunculi*, from which we may say that they differ essentially in two characters only; their perianth, instead of consisting of both calyx and corolla, is a petaloid calyx; and (the more important one) the adult carpels contain a single suspended ovule, with the micropyle turned upwards and inwards. But above it we observe (fig. 76) four rudimentary ovules in two

Anemone japonica.
FIG. 76. Carpel opened.

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[1] CASSINI (*Opusc. phytol.*, ii. 390) described the *caudex* of *Myosurus*, an organ which M. CLOS (*Ann. Sc. Nat.*, sér. 3, xiii. 10) refers to the collar.

[2] *M. apetalus* C. GAY, *Fl. Chil.*, i. 31, t. 1, fig. 1. The absence of petals is not constant in this species.

[3] GREN. & GODR., *Fl. Fr.*, i. 17.—REICHB., *Icon.*, iii. 1.—A. GRAY, *Ill.*, *Gen.*, i. 8.—BENTH., *Fl. Austral.*, i. 8.—J. HOOK., *Fl. Ant.*, i. t. 1, 2; *N. Zeal.*, 8; *Tasm.*, 5.—WEDDELL, *Chlor. And.*, ii. 306.—WALP., *Ann.*, i. 7.

[4] *Anemone* HALL., *Helvet.*, ii. 60.—T., *Instit.*, 275 (part.).—JUSS., *Gen.*, 232.—DC., *Prodr.*, i. 16.—SPACH, *Suit. à Buff.*, vii. 242.—ENDL., *Gen.*, n. 4773.—PAYER, *Organog.*, 254.—B. H., *Gen.*, 4, n. 4.—*Oriba* ADANS., *Fam. Pl.*, ii. 459.

vertical rows, which always remain in the state of cellular tubercles. Besides this the receptacle is convex; the stamens are numerous, as well as the carpels. All the other characters are variable. Take, for instance, the flower of *A. alba* Juss. (figs. 77, 78), or of any

Anemone alba.

FIG. 77.
Flower.

FIG. 78.
Longitudinal section of flower.

of the many allied species;[2] we see that the calyx is formed of five petaloid sepals quincuncially imbricated in the bud, and that the stamens are all fertile, each having a basifixed two-celled anther dehiscing by two nearly lateral clefts.[3] The ovaries are surmounted by a horn-shaped style of variable length, glabrous or hairy.[4] The flowers are terminal, and accompanied by a leafy involucre placed on the axis at a variable distance from the perianth. The other species of this genus have their flowers exactly similar in all fundamental points; but the number of pieces in the perianth is often increased, so that we sometimes find six, three outside, and three interior to these, alternate with them, and thinner

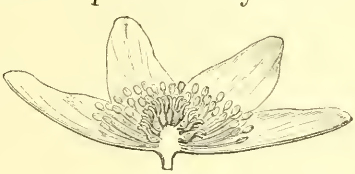
[1] See *Obs. sur les Ovules des Anémones et de quelques autres Renonculacées* (*Adansonia*, i. 331), and *Mém. sur la Fam. des Renonculacées* (*Adansonia*, iv. 52). It is only in exceptional cases that we see two, three, five, or six cellular prominences answering to abortive ovules.

[2] Which all belong to sections iv. (*Anemonanthea*) and v. (*Anemonopsis*) admitted by DE CANDOLLE (*Prodr.*, i. 18, 21), in the genus *Anemone*.

[3] The cleft is often turned rather inwards than outwards. This occurs in *A. alba, pennsylvanica* (*Adansonia*, iv. 16), *narcissiflora, nemorosa*, &c. The contrary is little marked in *A. japonica* (*alba*), *ranunculoides*, &c. The filaments are usually unequal, the lower being usually the shorter. We have also pointed out (*Adansonia*, i. 337) the two glandular projections found on each side of the top of the filament in a large number of species.

[4] Several authors following DE CANDOLLE'S example have made use of this character to establish sections of the genus. Thus, *Pulsatilla* (*Prodr.*, i. 16,) and *Preonanthus* (17) have carpels surmounted by long bearded styles like those of certain species of *Clematis*. The sections *Anemonanthea, Anemonospermos*, and *Omalocarpus* (21) are, on the contrary, marked by styles that project but little.

and more coloured; so that we have a double verticil. Elsewhere the number of petaloid leaves becomes much larger, either on account of the deduplication of the interior ones, and their replacement by pairs of appendages, or owing to the gradual transformation of the outer stamens into coloured blades, so that the flower tends to become double.[1] In *A. nemorosa* L., the Wood Anemone (Fr. *Sylvie*, figs. 79, 80), the normal number is six sepals in two whorls, so that this and all the allied species[2] are to the other Anemones what the *Ficariæ* are to the *Ranunculi*, properly so called. The other parts of the flower present variations of only secondary importance in the numerous species of this genus. Thus the stamens are usually all fertile; but in *Pulsatilla*[3] the outer stamens, shorter than the rest, become quite sterile, and are represented by more or less glandular staminodes. The carpels, instead of being surmounted by a slightly projecting horn, may be produced above into a long bearded tail; and many authors have used these



Anemone nemorosa.

FIG. 80. Longitudinal section of flower.

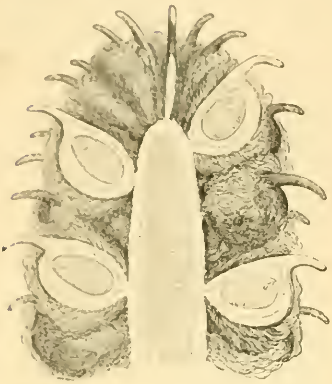
FIG. 79.

[1] See on the subject of Anemones with double flowers the now classical work of DE CANDOLLE (*l. cit.*, 388) which contains the names given by florists to the different parts of the double flowers of Anemones. Besides modifications in form and size, all the parts of the flower may become chloranthous. In the monstrous Wood Anemones often cultivated in our gardens, the stamens usually become sterile, still retaining, however, somewhat of the normal form and tint. The largest, spathulate petaloid blades, which are found towards the centre of the flower, and are the better developed as they approach it, are due to the metamorphosis of the carpels.

[2] *Prodr.*, i. 20. In some years and localities the Wood Anemones have always six sepals; those with eight sepals have been common this year [1867? TRANS.] at Meudon. In this species, as in many others, the flower droops as it fructifies. ADANSON calls the Wood Anemone "*Oriba*" (*loc. cit.*, 459).

[3] *Anemone Pulsatilla* L., *Spec.*, 759.—DC., *Prodr.*, i. 17.—*Pulsatilla* T., *Instit.*, 284, t. 148.—SPACH, *Suit. à Buff.*, vii. 253.

distinctions in forming a certain number of sections in the genus Anemone.[1] The achene itself may be either glabrous, or covered with a thick down, which, as in *A. virginiana* (figs. 81 and 82), envelopes all the carpels with a kind of fleece, which assists in their dispersion.[2]



Anemone virginiana.

FIG. 82. Longitudinal section of fruit.

FIG. 81. Fruit.

All the Anemones are herbs with perennial subterranean stems, much branched, and known in commerce as "roots" (Fr. *pattes*).[3] These rhizomes give rise to aerial branches, which bear usually alternate leaves, often perfect, the petiole dilated into a sheath below, the blade simple, lobed, or even deeply dissected and compound, which difference may be noticed in passing from one leaf to another on the same plant. The flowers are usually terminal, and often solitary; but otherwise younger flowers spring from the axils of the upper leaves, forming a sort of cyme with a recurrent inflorescence. Most usually one or several of the uppermost leaves form under the flower an involucre, which may simulate a calycine whorl. Sometimes its elements are independent of one another, and the leaves may even retain their petioles, as in the Wood Anemone. (fig. 79). Sometimes, on the contrary, they become connate, so that the involucre appears single below, while above it is variably divided. Its leaves are sometimes sterile, and sometimes provided with axillary buds, which expand after the terminal flower.[4] Usually the involucre

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[1] See p. 42, note 4.

[2] DE CANDOLLE makes this the chief characteristic of his section *Pulsatilloides,* which includes only species from the Cape.

[3] On the subterranean organs of most *Ranunculaceæ* (as we have already said), and especially on those of the Anemones, the whole of the remarkable works of IRMISCH should be read. What refers to the Anemones was published in the *Botanische Zeitung* (4, Jan. 11, 1856) and translated in the *Ann. Sc. Nat.* (sér. 4, vi. 214). In this work, the author refers to other publications of himself and others on the same subject; he describes the mode of formation of the more or less ramified rhizomes of the Anemones, especially *A. coronaria, Pulsatilla,* and *Hepatica.* He further shows that the plan of evolution of the subterranean parts might be used to characterise certain sections in the genus *Anemone;* and hence, refusing to leave *A. nemorosa* and *ranunculoides* in the same group with *A. sylvestris* and *baldensis,* he proposes to establish a distinct section for these last, which he terms *Hyalectryon.*

[4] This is constant in each of the leaves of the involucre of *A. narcissiflora* L., which DE CANDOLLE makes the type of his section *Omalocarpus,* and of the neighbouring species, *A. sibirica,*

is at some distance from the flower; but in *Hepatica*,[1] and *Barneoudia*,[2] the sessile leaves are normally so near the coloured perianth as to play the part of a true foliaceous calyx. Finally, in some species, it is said, the involucre is completely wanting.[3]

Adonis[4] has been considered by all botanists as a distinct genus from *Anemone*, because the inner leaves of the perianth are more distinctly petaloid than the outer ones, which their more greenish tint has alone led to be considered as sepals. But we shall not admit this separation, because this difference in the coloration and texture of the two whorls of the perianth exists also, though to a less degree

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umbellata. The principal axis ends in a flower, and the younger flowers axillary to the leaves of the involucre grow quickly enough to simulate a sort of umbel with the central flower. This is in appearance only, however, for the inflorescence is really a centrifugal cyme with only secondary flowers. In other species, as *A. virginiana*, *ranunculoides*, we usually only observe two flowers—one terminal, the other in the axils of one of the bracts of the involucre. JUSSIEU long ago remarked (*Mém. Acad. Ann.* 73, p. 229) that one of these flowers may have only male organs. In *A. nemorosa*, the existence of the lateral flower is quite exceptional (See *Bull. Soc. Bot. Fr.*, vi. 290).

[1] *Hepatica* DILL., *Nov. Gen. Giess.*, 108.—DC., *Prodr.*, i. 22.—SPACH, *Suit. à Buff.*, vii. 240.—*H. triloba* CHAIX. ap. VILL., *Dauph.*, i. 336.—*H. nobilis* REICHB., *Ic. Ran.*, 47.—*Anemone Hepatica* L., *Spec.*, 758.—GREN. & GODR., *Fl. Fr.*, i. 15. The petaloid perianth of *Hepatica* is double and trimerous, the outer whorl alternating with the involucre, and the inner whorl with the outer; but this inner whorl has far more often four, five, or more leaves, owing to the occurrence of the deduplication. The lateral anther cells have a nearly marginal dehiscence, rather introrse than extrorse. Each carpel contains five ovules, the development of the four highest of which (arranged in two pairs) is early arrested (*Adansonia*, ii. 206). Another very remarkable peculiarity of *Hepatica* is that of its mode of growth, very clearly explained by BRAUN in his work, *Das Individuum der Pflanze* (63, 73, t. 1, fig. 3). We have seen (*Adansonia*, ii. 204) that the rhizomes of *Hepatica* bear buds destined to become true branches in the following Spring, bearing leaves and flowers. "These branches with very short axes at first bear alternate whitish scales. These are enlarged petiolary sheaths, and may bear a small rudimentary blade at the tip. The lowest are sterile, but higher up each bears a flower in its axil. Still higher the scales become perfect three-lobed leaves. This explains how it is that the flowers of this plant appear above ground before the leaves. The parts expand in order of formation: first the flowers, answering to the scales or lower leaves, and afterwards the leaves at the top of the branch." Finally, the flowers of *Hepatica* are axillary, and the axis of vegetation not terminated. See here, as elsewhere, the works of IRMISCH (p. 44, note 3).

It is only exceptionally that the involucre of *Hepatica* is at a distance from the flower. It is normally so near it as to play the part of a calyx to the petaloid pieces of the perianth. We may, indeed, even consider it as such, following PAYER (*Organog.*, 254), who regards it as analogous to that of *Ficaria* (see *Adansonia*, ii. 201). It is difficult to pronounce decisively what absolute value we must assign to the involucres and calyces in a family of plants which instead of being, as is usually held, a type of organic perfection, is probably a collection of degenerate types in which there is no precise boundary-line between the floral organs and those of vegetation. (See, on this subject, M. CHATIN'S work entitled *Essai sur la Mesure d'Elevation, ou de Perfection Organique*, &c.) We have seen the involucre of *A. pavonina* entirely formed of red petaloid blades like those which usually form a perianth, and at a variable distance from the rest of the flower.

[2] *Barneoudia chilensis* C. GAY, *Fl. Chil.*, i. 29, t. 1, fig. 2.—*Anemone* B. H., *Gen.*, 4.—The leaves of the involucre, five or six in number, closely applied to the flower are considered by BENTHAM & HOOKER as only three leaves, bipartite and lobed.

[3] "*In* A. integrifolia SPR., PRITZ., *Linnæa*, xv. 694 (Hamadryade andicola HOOK., *Icon. Pl.* ii., t. 137), *involucrum omnino deest. Cætera omnia cum* Anemone *conveniunt*" (B. H., *Gen.*, 4).

[4] *Adonis* DILL., *Nov. Gen. Giess.*, 109.—L., *Gen.*, n. 698.—J., *Gen.*, 232.—DC., *Prodr.*, i. 23.—SPACH, *Suit. à Buff.*, vii. 222.—ENDL., *Gen.*, n. 4778.—STEV., *Ann. Sc. Nat.*, sér. 3, xii. 370.—B. H., *Gen.*, 5, n. 6.—H. BN. *Adansonia*, iv. 52.—*Ranunculi* spec. T., 291.—*Sarpedonia* ADANS., *Fam. Pl.*, ii. 601.

in many Anemones, and because the species of *Adonis* have also the singular character, that of their ovules, at first five in number, the inferior one alone is completely developed and usually becomes pendulous,[1] with the raphe dorsal and the micropyle turned upwards and inwards. The fruits of the Adonids are more fleshy than those of the Anemones before they are perfectly matured; indeed, at one stage they form true drupes.[2] The total number of pieces in the perianth varies as in the Anemones. They are annual herbs, like, for example, *A. autumnalis* L., vulgarly known as "Pheasant's Eye" (Fr. *Goutte-de-sang*, fig. 83), or perennials, whose subterranean part grows in the same way as in the Anemones. This is especially the

Adonis autumnalis.
FIG. 83.
Flower.

Adonis vernalis.
FIG. 84.
Flower.

case with *A. vernalis* L. (fig. 84), and in the closely allied species which

[1] We have shown (*Adansonia*, ii. 209) that in the section *Consiligo* the ovules are sometimes pendulous with the ovule upwards and inwards, and sometimes ascending with the micropyle downwards and inwards; but all this amounts to the same, as it only depends on the great relative increase of the back of the carpel in its lower or upper part. As to the existence of five ovules in the first stage of the carpels, it is easy to show in the young flowers of *A. autumnalis* and *æstivalis* L., and in the ripe state we find the four superior ovules as small, cellular projections (*Adansonia*, i. 335).

[2] The fruits of *A. vernalis* are arranged on the accrescent receptacle in a spiral order, of which may be clearly seen the three secondary spirals in one direction, and five in the other. The fruits dry up rapidly on falling off the axis. But if we examine them before their fall, we see that each is a true drupe, with the style persisting as a little recurved horn. The mesocarp is fleshy; the endocarp represents a dark, foveolate, testaceous, brittle shell. The seed is usually ascending, even when it succeeds a descending ovule; this is owing to the unequal growth of the different parts of the fruit as it ripens. The hilum is turned downwards and inwards; but not quite inferior, as the seed is now only hemitropous, and the micropyle is much lower and more exterior. The seed has two very distinct coats; the outer of loosely packed cells, the other of more compacted elements. In *A. æstivalis*, too, the seed is covered with a foveolate, thick, very hard shell, and by a mesocarp which is at first fleshy and greenish. In both species the ovule has two coats.

with it constitute the group *Consiligo*,[1] plants with yellow flowers, petals usually very numerous,[2] and an involucre completely surrounding the floriferous axis as in most Anemones.

Knowltonia[3] is a group of plants from the Cape, which have all the floral characteristics of *Consiligo*, and therefore of *Adonis*, from which they only differ in the truly fleshy consistency of the pericarp, and the habit and foliage which recal those of some of the Umbellifers and of certain species of the genus *Anemone*, to which we must equally unite *Knowltonia*.

Thus constituted,[4] our genus *Anemone* includes about eighty

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[1] *Adonis*, sect. ii. *Consiligo* DC., *Prodr.*, i. 24. —*Gen. Adamanthe* SPACH, *Suit. à Buff.*, vii. 277. Its type is *A. vernalis* L. (*Spec.*, 771) whose organization we have specially studied (*Adansonia*, i. 335; ii. 209; iii. 53). The most striking character of plants of this group is that their subterranean stems are perennial as in the true Anemones. If we study one of these rhizomes before the winter we see that it bears adventitious roots and large shoots, some only leafy, others terminated by a flower. Each first bears scales and then imbricated leaves. These scales represent the petiolary sheaths as they are often seen surmounted by a rudimentary blade. Like the leaves they have often axillary buds, which by their development cause the great ramification of the rhizome. The already formed flowers show that the petals continue the spiral series of stamens externally without its being possible to fix the boundaries between them; so we ought, in all probability, to consider them as staminodes like the nectaries of the Hellebores, &c.

[2] *A. æstivalis* may have flowers with only five interior leaves or petals to the perianth. More usually a certain number of them are deduplicated; then occupying the intervals between the sepals in groups of two, three, or more, as in the Hepaticas and the Wood Anemone. In *Consiligo* there are often as many as fifteen, twenty, or more of these inner leaves.

[3] *Knowltonia* SALISB., *Prodr.*, 372.—DC., *Prodr.*, i. 23.—SPACH, *Suit. à Buff.*, vii. 231.—ENDL., *Gen.*, n. 4775.—B. H., *Gen.* 4, n. 5. —HARV. & SOND., *Fl. Cap.*, i. 4.—*K. rigida* SALISB. (*K. hirsuta* DC.—*Anamenia coriacea* VENT., *Malmais.*, i. t. 22.—*Adonis capensis* THUNB.—L., *Spec.*, 772) is often cultivated in our botanical gardens. As we have stated (*Horticul. Franç.*, xv. 2, t. vi. and *Adansonia*, iv. 52), the perianth is formed of a score of somewhat greenish-yellow leaves, without any distinction of colour between calyx and corolla. In this respect it resembles exactly an Anemone like *A. japonica*, whose inner sepals may be numerous, imbricated, and narrow, but are otherwise similar to the outer ones. The habit, foliage, and inflorescence are the same in both, only the flower of *Knowltonia* is somewhat smaller. The only differentiating character is that the fruit of the latter becomes fleshy when fully mature. In this respect *Adonis*, with its fruits that remain drupaceous for some time, stands intermediate between the true Anemones and *Knowltonia*. But here, as with the other *Ranunculaceæ*, we lay but little stress on the consistency of the perianth. The stamens are indefinite, the outer ones shortest; the anther dehisces laterally, and the filament forms a small projection beneath it on each side as in the Anemones. The carpels are on short stalks, and the style is horn-shaped, with a groove on the inner surface, whose lips are charged with stigmatic papillæ.

[4] According to our views (*Adansonia*, iv. 52) this genus consists of the following sections—

I. *Outer stamens sterile:*

1. *Pulsatilla* (T.).

II. *Stamens all fertile:*

2. *Euanemone.* Involucre at a distance from the perianth which is either simple quincuncial and pentamerous, or provided in addition with a variable number of internal imbricated leaves. DE CANDOLLE's sections, with two exceptions, are included in this group as secondary divisions.

3. *Hepatica* (DILL.). Involucre near the perianth, which is trimerous, with frequent deduplication in the inner whorl.

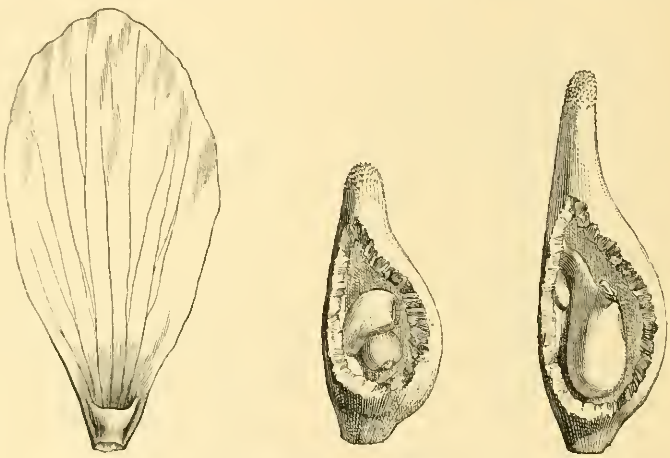
4. *Adonis* (DILL.). Perianth double or triple, with the inner leaves petaloid and the outer leaves more or less green (sepaloid). Flowers primary. Fruit drupaceous, at least for a certain time. Involucre very imperfect.

5. *Knowltonia* (SALISB.). Perianth with multiple leaves, the outer little if at all distinct from the inner in either consistency or coloration. Fruit bacciform.

6. *Consiligo* (DC.). Perianth with multiple leaves, the inner a little more distinct from the outer than in section 5, and less so than in section 4. Fruit half fleshy at maturity. Involucre more complete than in section 4.

species of plants, often cultivated for the beauty of their flowers, and found chiefly growing in the temperate regions and cold and hilly countries all over the world. *Knowltonia* and *Adonis* belong only to the Old Continent; but the true *Anemones*, though more abundant in Europe and Asia,[1] are also met with in America.[2]

Ranunculus rutæfolius L.,[3] which has become the type of a small genus under the name *Callianthemum*,[4] presents, with the habit of a *Ranunculus*, flowers which are externally exactly like those of an *Adonis*. The perianth consists of a herbaceous quincuncial perianth and a double corolla with membranous leaves, variable in number and subject to deduplication.[5] The base of each petal (fig. 85) has



Callianthemum rutæfolium.

FIG. 85. Petal.

FIG. 86. FIG. 87. Carpels opened at different ages.

a small nectariferous depression with the inner border nearly horizontal; the stamens are indefinite.[6] But the chief characteristic of

[1] WALP., *Rep.*, i. 14; ii. 738; v. 4; *Ann.*, i. 6; ii. 5; iv. 13.—HOOK. & TH., *Fl. Ind.*, i. 19.—HARV. & SOND., *Fl. Cap.*, i. 5.—BENTH., *Fl. Austr.*, i. 8.—S. & ZUCC., *Fl. Jap. Fam.*, 70.

[2] C. GAY, *Fl. Chil.*, i. 19.—A. GRAY, *Gen. Ill.*, t. 3-5.—WEDDELL, *Chloris andina*, ii. 298. —A. S. H., *Fl. Bras. Mer.*, i. 4.—MART., *Fl. Brasil.*, Renonc., 150.

[3] *Spec. Pl.*, 777.—JACQ., *Coll.*, i. 186, t. 6, 7. —DC., *Prodr.*, i. 30.—*Ranunculus Bellardi* VILL., *Dauph.*, 4, t. 49.

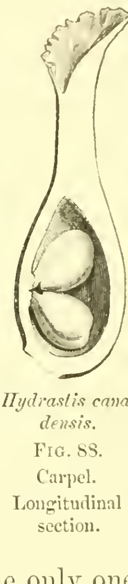
[4] C. A. MEY., *in* LEDEB., *Fl. Alt.*, ii. 336.— ENDL., *Gen.*, n. 4779.—B. H., *Gen.* 5. n. 7.— WALP., *Rep.*, i. 33; *Ann.*, iv. 16.—H. BN., *Adansonia*, iv. 23, 53.

[5] The corolla of *C. rutæfolium* C. A. MEY. is double. The outer whorl is formed of five petals alternating with the caducous sepals. The inner one is formed of one, two, or as many as to five petals, which alternate with the former, and of which several may undergo deduplication. The flowers then have from six or seven to fifteen petals, and when these are numerous the inner ones are relatively narrow.

[6] In *C. acaule* CAMB. the anthers have a marginal dehiscence. In *C. rutæfolium* C. A. MEY., it is just a little more interior than exterior. In both the filaments are flattened and the anthers basifixed.

the order is that each carpel originally contains two ovules, of which one alone attains its full development, and appears suspended beside its aborted fellow, with the raphe internal and the micropyle turned upwards and outwards.[1] *Callianthemum* has, therefore, but one seed in each achene. The plants are herbaceous perennials, with alternate compound leaves and terminal flowers. As yet but two species are known; one European[2] and the other Asiatic.[3]

The Canadian plant *Hydrastis*,[4] which we refer with some doubt to this group,[5] has regular flowers, usually[6] hermaphrodite; the perianth, simple and very caducous,[7] consists of only three petaloid leaves. Above this the receptacle, of the same form as in *Ranunculus*, bears numerous stamens and then carpels. The stamens are free, each consisting of a filament dilated above, and a basifixed anther with two cells dehiscing by nearly lateral clefts.[8] Each carpel is composed of a unilocular ovary, tapering above into a style, whose apex is dilated into two lateral papillose and fringed lips. Half-way up the inner angle of the ovary (fig. 88) the placenta forms two vertical projections, each supporting an ovule. These ovules are at first horizontal and placed back to back; but as they grow, one becomes ascending with the micropyle usually downwards and outwards, the other descending with the micropyle upwards and inwards. The fruit consists of a variable number of berries united into a head, and buried in the mass we find seeds with thick coats containing a small embryo at the apex of abundant fleshy albumen. This plant, the only one



Hydrastis canadensis.
FIG. 88.
Carpel. Longitudinal section.

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[1] We explained for the first time in our *Mémoire sur la Famille des Renonculacées* (*Adansonia*, iv. 23) how in *C. rutæfolium* there are first of all two ascending ovules; then how the one of them, which has become superior, compresses the other and forces it down, increasing gradually at its chalazal end, so that its micropyle remains above and turned outwards. Figs. 86 and 87 represent two phases of the evolution of these ovules. That which becomes fertile has two coats. In *C. acaule* the carpels are stipitate, and the stigmatic papillæ are borne on the summit of the ovary. In *C. rutæfolium* the ovary tapers above into a style papillose at the summit.

[2] REICHB., *Icon.*, iii. 25.—GREN. & GODR., *Fl. Fr.*, i. 17.

[3] CAMB., *in* JACQUEM., *Voy.*, 5, t. 3.—DON., *in* ROYL., *Himal.*, iii. 45, 53.—HOOK. & TH., *Fl. Ind.*, i. 26.

[4] *Hydrastis canadensis* L., *Spec.*, 784.—J., *Gen.*, 232.—MICHX., *Am. Bor.*, i. 317.—DC., *Prodr.*, i. 23.—SPACH, *Suit. à Buff.*, vii. 383.—ENDL., *Gen.*, n. 4777.—HOOK., *Bot. Mag.*, t. 3019, 3232.—A. GRAY, *Gen. Ill.*, t. 18.—*B. H.*, *Gen.*, 7, n. 16.—H. BN., *Adansonia*, iv. 25, 53.—*Warneria canadensis* MILL., *Icon.*, ii. 190, t. 285.

[5] Its habit and flowers bring it somewhat near *Actæa*. Most authors make it a Hellebore.

[6] Sometimes there are flowers without a gynæceum.

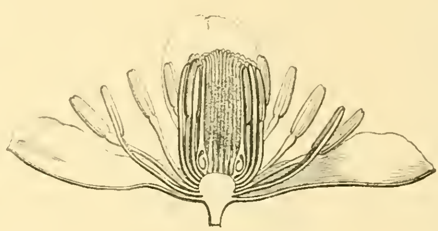
[7] Hence we are ignorant of its æstivation, which can hardly be observed except on a living plant.

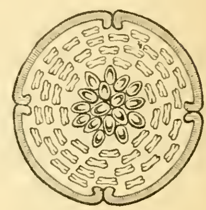
[8] Nearer, however, the internal than the external face.

of its genus, grows in Canada and the United States. From its stock a stem arises in the spring, which bears only a small number of alternate petiolate palmatifid leaves,[1] and is terminated by a solitary flower.

III. CLEMATIS SERIES.

The genus *Clematis*[2] has regular, usually hermaphrodite, flowers. In a large number of the species cultivated by us as ornamental plants—as, for instance, *C. montana*, BENTH. (fig. 89)—we find at the base of the convex floral receptacle (figs. 90, 91) a single petaloid perianth consisting of a calyx of four free sepals,[3] valvate of in-





Clematis montana.

FIG. 89. Flower.

FIG. 90. Longitudinal section of flower.

FIG. 91. Diagram.

duplicative[4] præfloration. The numerous hypogynous stamens each consist of a free filament, and a basifixed anther with two lateral

[1] The superior leaf is usually sessile. The inferior has often two small glands at the base of its petiole.

[2] *Clematis* L., *Gen.*, n. 696.—JUSS., *Gen.*, 232.—DC., *Prodr.*, i. 2.—ENDL., *Gen.*, n. 4768.—SPACH, *Suit. à Buff.*, vii. 257.—B. H., *Gen.*, 3.—WALP., *Rep.*, i. 3; ii. 737; v. 3; *Ann.*, i. 3, 953; ii. 3, 5; iv. 3, 9.—*Clematitis* T., *Instit.*, 293, t. 150; *Cor.* 20.—*Trigula* NORONH.—*Stylurus* RAFIN.—*Clematopsis* BOJ.

[3] Two of these sepals are lateral; the two others are anterior and posterior. PAYER (*Organog.*, 252) has seen that they arise in twos; the former pair after the latter.

[4] The sepals therefore touch, not by their edges, but by the lateral portions of their outer surface. The portion thus inflected in the bud varies in extent in different species; and when it is very large the sepal is here thinner, and usually of a paler tint. Later on, after the expansion of the flower, the sepals which were valvate may even overlap one another by the thin expanded margins, as we have ascertained (*Adansonia*, iv. 53). We have also shown (*l. cit.*, 55) that then the flower of a *Clematis* becomes exactly that of an *Anemone*, and so the two series are closely bound together, and might even be confounded when we add that "the outer stamens of *Clematis* become staminodes in *Atragene* and *Naravelia*, as happens in the section *Pulsatilla* of the genus *Anemone*; that the fruit of this same *Pulsatilla* is exactly that of *Flammula*; and finally, that in *Cheiropsis* the flower has an involucre wanting in the other sections of the genus *Clematis*, but recalling that of the true *Anemones*." The habit, too, of *Anemone japonica* is met with in *C. tubulosa* and some others.

adnate cells, dehiscing longitudinally by nearly marginal clefts.[1] The carpels, also very numerous, are each composed of a unilocular ovary, surmounted by a style grooved vertically along the whole of its inner border, and slightly dilated at the tip. The whole of the upper part of its lips is covered with stigmatic papillæ. In the inner angle of the ovary is a placenta which bears a fertile descending ovule with its micropyle upwards and inwards; and above it, in two vertical rows, are a few[2] sterile ovules reduced to minute cellular nuclei. The fruit is multiple, consisting of as many achenes as there were carpels; the fleshy albumen[3] of the seed surrounds a minute embryo.

In other species of this genus, such as Traveller's Joy (*C. Vitalba* L., Fr. *Herbe aux Gueux*) the flower may equally consist of four sepals, or it may have five, six, or more. From six to eight or ten are almost constantly found in the beautiful large-flowered species cultivated in our conservatories, as *C. lanuginosa*, *patens*, *florida*, &c. The æstivation is on the whole the same as in *C. Vitalba*, but the thin

Clematis Viticella.
FIG. 92.
Fruit.

Clematis Vitalba.
FIG. 93.
Fruit.

inflexed portion of the sepal is here much broader.[4] We find the same condition in *C. Viticella* L., and the other species which have been united with it into a special section.[5] They are also distinguished by another feature; the achene is only surmounted by a short point (fig. 92) formed by the persistent base of the style. In the other species, such as *C. Vitalba*, the style persists on the summit

[1] In *C. Viticella* the lines of dehiscence are slightly internal; so too in *C. Vitalba*. They are decidedly lateral in *C. cirrhosa*; introrse in *Atragene* and *Naravelia*. Messrs. BENTHAM & HOOKER say (*Gen.* i.): "*Antheræ introrsum dehiscant in* Clematidibus 2 *indicis*."

[2] The number varies; there are usually four in two vertical rows; more rarely two only, or six or eight. The superior ovules are always the least developed. M. RŒPER saw, in 1849 (*Bot. Zeit.*, 1852, col. 187), four ovules in *C. integrifolia*. PAYER was the first to show, in *C. calycina*, the order of the evolution of the five ovules (*Organog.*, 253, t. 58). The existence of these abortive ovules is another mark of the resemblance between *Clematis* and *Anemone*.

[3] Its consistency varies; it may even become quite horny.

[4] It is especially in these that we have imbrication after the opening of the flower. (See note 4, p. 50.)

[5] *Viticella* DILL., *Nov. Gen. Giess.* 165.—SPACH, *Suit. à Buff.* vii. 272.—Sect. ii., DC., *Syst.* i. 160, *Prodr.* i. 8. *Viticella*, admitted as a genus by SERINGE (*Fl. des Jard.* &c., iii. 80), includes *Clematis Viticella*, *Viorna florida*, *cærulea* and *cylindrica*.

of the fruit as a long plume covered with hairs which render it quite feathery (fig. 93). Other species form a transition between these,[1] as these hairs are only developed on the lower part of the style, leaving the stigmatic portion naked; such, for example, is *C. fœtida* Raoul (fig. 94).

Clematis fœtida.
Fig. 94.
Carpel.[2]

C. cirrhosa L. and some nearly allied species have been grouped by De Candolle[3] into a separate section, as the flower possesses an involucre formed of two lateral bracts, cohering for a great part of their length, and entirely enclosing the bud when young. The calyx has here also four sepals. Above this the receptacle becomes ovoidal, bearing numerous stamens, each with a filament flattened below, and an anther whose lateral cells dehisce by somewhat introrse clefts. The surface of the style is almost entirely covered with long villi.

Finally there are species of this genus where the flowers become polygamous or monœcious by the abortion of one set of sexual organs, and other species where the flowers of different sexes grow on different plants, as in *C. diœca* L. which grows at the Antilles.[4]

Linnæus separated *Atragene*[5] from the genus *Clematis* (in which De Candolle again replaced it),[6] because its flowers possess corollas.

Clematis alpina.

Fig. 95.
Flower.

Fig. 96.
Longitudinal section of flower.

But the petaloid tongues, from twelve to twenty in number, found within the calyx of *A. alpina* (figs. 95, 96) or *sibirica*[7] are not true

[1] Sect. *Flammula* DC., *Prodr.*, i. 2 (incl. *Viorna* Spach, *Suit. à Buff.*, vii. 268).
[2] After Raoul, *Choix de Pl. N. Zél.*, t. xxii.
[3] *Cheiropsis* DC., *Syst.*, i. 162; *Prodr.*, i. 9.—Cambess., *Fl. Balear.* (*in Mém. Mus.*, vii. 201).
[4] To me this species appears polygamous, rather than diœcious as the descriptions assert.
[5] *Atragene* L., *Gen.*, n. 695.—Juss., *Gen.*, 232.—Endl., *Gen.*, n. 4769.—Spach, *Suit. à Buff.*, vii. 257 (A. Gras (*in Bull. Soc. Bot. Fr.*, vii. 907) proposes to write *Athragene*).
[6] *Syst.*, i. 165.—*Prodr.*, i. 9 (sect. iv).
[7] *Clematis alpina* and *sibirica* Mill., *Dict.*, n. 9, 12.—*Clematitis alpina* T., *Inst.* 294.

petals. Not one of these appendages is truly alternate with any of the four valvate sepals of the calyx. As we approach the centre of the flower, we find the kind of spathulate expansion at their summit gradually transformed into a connective, bearing on its inner face two anther cells dehiscing longitudinally. At the same time the basilar portion becomes contracted to form a true filament. The "petals" of *Atragene* are therefore only staminodes.[1] Besides, the numerous carpels of *Atragene* have this in common with those of *Clematis*, that the ovule observed on the inner angle of the ovary has above it four small ovules in two vertical rows, which never become developed.[2]

The genus *Naravelia*[3] was established for certain Indian species of *Atragene*, whose leaves, instead of being three-lobed, have the middle segment abortive, or transformed into a tendril. If we analyse *N. zeylanica*,[4] we find a pubescent calyx of four, five, or six valvate sepals, and within this a large number of imbricated stamens, with flattened filaments, and two-celled introrse anthers,[5] dehiscing longitudinally, each surmounted by a small prolongation of the connective. The carpels are numerous, covered with stiff, erect hairs; and each encloses a suspended ovule with the micropyle turned upwards and inwards. This is the only one completely developed; but above it, when young, are four others in pairs on each side of the suture of the carpel, of which traces are with difficulty found when the fertile one is adult. This is another relation with *Atragene*, of which *Naravelia* also possesses the corolla formed of very long petals dilated at the summit and varying in number.[6] But these are only sterile stamens. For a long time they are very small, shaped like the outer stamens, and presenting above an anther-like swelling, which never becomes fertile. Hence we cannot separate *Atragene* and *Naravelia* generically from each other, and therefore not from *Clematis*.

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[1] We must unite these types into one genus, for the same reason as we include *Pulsatilla* in *Anemone*, and because, as we shall soon find, we cannot separate from the true *Hibbertias* those species in which the outer stamens are transformed into staminodes, &c. In several cultivated species of *Clematis* the flower becomes double, like that of the *Anemones*.

[2] Here also it is the study of organogeny which revealed to us (*Adansonia*, i. 334) the existence of these small sterile ovules. Even five or six may be found.

[3] *Naravael* HERM., *Zeylan.*, 26.

[4] *N. zeylanica* DC., *Prodr.*, i. 10.—HOOK. & TH., *Fl. Ind.*, i. 3.—B. H., *Gen.*, 4.—*Atragene zeylanica* L., *Amœn.*, i. 405.

[5] ENDLICHER (*Gen.*, n. 4470) believed these stamens to be extrorse, which would have removed these plants further from *Atragene*. But in *N. zeylanica* they are distinctly introrse.

[6] From five to fifteen.

Thus constituted[1] the genus *Clematis* includes woody, usually climbing plants, rarely suffrutescent or herbaceous, with the leaves always opposite and exstipulate, simple or compound, ternate or pinnate, the petiole of variable length and sometimes twining.[2] In *Naravelia* it bears two leaflets, and is then prolonged into a tendril which supports the branches. We shall see later on that the structure of these and of the stem presents very peculiar characters. The flowers may be terminal or axillary, solitary as in *C. Viticella* L., or, as in *C. Vitalba* L., in cymes which are themselves united into a raceme with opposite ramifications. In certain species with precocious flowering (as *C. montana* Benth.) the flowers are axillary, not to the leaves themselves, but to the bracts which represent them in the lower part of the bud; above the flowers the branch afterwards bears true leaves, with leaf-buds axillary to them. This genus includes about a hundred genera, inhabitants of all the temperate regions of both hemispheres, or even of the warmest countries, as South America,[3] the borders of the Indian ocean, Eastern Asia,[4] Australia,[5] and as far south as New Zealand[6] and Tasmania.[7]

Thalictrum[8] is easy to characterize when we know *Clematis;* it is *Clematis*, but with an imbricate æstivation and alternate leaves. If we examine, for example, *T. aquilegifolium* L. (figs. 97, 98), we see that the flower is hermaphrodite, and that the pedicel, a little swollen above, is continued into a conical depressed receptacle which bears the coloured perianth, the androceum and the gynæceum, one after another. The calyx is formed of four[9] decussate free sepals of alternative-imbricate æstivation.[10] These leaves have an articulation as it were at the base, and fall early from the receptacle. The

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1 *Clematis.* Sections 7.
1. *Atragene* (L.).
2. *Naravelia* (L.).
3. *Cheiropsis* (DC.).
4. *Meclatis* (Spach).
5. *Viorna* (Pers.). — *Muralta* (Adans., ex Endl.).
6. *Viticella* (Mœnch).
7. *Flammula* (DC.).

Valvaria is a genus admitted by Seringe (*op. cit.*, iii. 93) for *Clematis integrifolia*, *ochroleuca*, and *ovata*.

2 It has been noticed that the petioles may twine in either direction; and that in the species with persistent leaves the tendrils formed by their petioles persist also.

3 A. S. H., *Fl. Bras. mer.*, i. 1.—Mart., *Fl. Bras.*, *Ranunc.*, 146.

4 Roxburgh, *Pl. Coromand.*, t. 188.—Hook. & Thoms., *Fl. Ind.*, i. 4.—Sieb. & Zucc., *Fl. Jap. Fam.*, 68.

5 Benth. & F. Muell., *Fl. Austral.*, i. 1.

6 Hook. F., *Fl. N. Zealand*, 6.

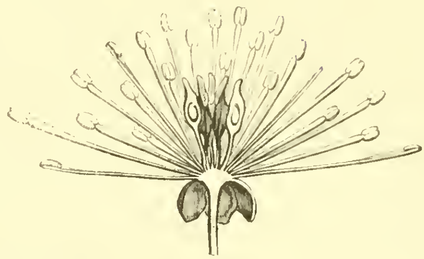
7 Hook. F., *Fl. Tasman.*, 2.

8 *Thalictrum* T., *Inst.*, 270, t. 143; *Cor.*, 20.—L., *Gen.*, n. 697.—Juss., *Gen.* 232.—DC., *Prodr.*, i. 11.—Spach, *Suit. à Buff.*, vii. 237.—Endl., *Gen.*, n. 4772.—Payer, *Organog.*, 253, t. lviii.—B. H., *Gen.*, 4, n. 3.—H. Bn., *Adansonia*, iv. 54.

9 There are flowers with five sepals imbricated (sometimes quincuncially), or more rarely with six, seven, and upwards.

10 The imbrication may be different even with four sepals.

stamens are very numerous, free, and hypogynous; each consists of a filament with a club-shaped swelling below its summit, which



Thalictrum aquilegifolium.

FIG. 97. Flower.

FIG. 98. Longitudinal section of flower.

tapers to a point[1] to support the two-celled basifixed anther that dehisces marginally or somewhat internally by two longitudinal clefts.[2] The gynæceum is formed of an indefinite number of free carpels,[3] each borne on a slender stalk,[4] and composed of an ovary which tapers above into a beak grooved longitudinally along the inner angle. The thickened and everted edges of this groove are covered with stigmatic papillæ. In the inner angle of the cell of the ovary is a single ovule, suspended, with its raphe dorsal, and the micropyle looking upwards and inwards.[5] The fruit consists of several achenes (fig. 99), whose form varies according to the species;[6] and in the suspended seed (fig. 100) we find copious albumen, with a small embryo near the summit.

Thalictrum elatum.

FIG. 99. Fruit.

FIG. 100. Longitudinal section of flower.

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[1] The filaments are here erect and divergent. In many species they are slender and capillary, and yet very long; so that after the flower has opened they hang down the pedicel.

[2] The anthers are sometimes apiculate, as in *T. sylvaticum* KOCH. When the dehiscence is quite marginal, as in *C. exaltatum* C. A. MEY., *majus* MURR., &c., each cell opens out into two equal panels, which spread out and become plane, so as to touch the walls of the neighbouring cell. Each anther has then the form of a double flat plate placed edgewise, and, as it were, in a line with a radius of the flower; and all that is seen of it is the inside of its cells, from which all the pollen falls off. Sometimes cultivation transforms some of the outer stamens into petals, as in *Clematis*.

[3] When the carpels are four in number, like the sepals, it may happen that the former seem to alternate exactly with the latter. But this relation is certainly not constant.

[4] This stalk is wanting in all the species of which DE CANDOLLE makes his section iii., *Euthalictrum* (*Syst.*, i. 172; *Prodr.*, i. 12).

[5] This ovule has two coats. Above it may be seen a slight swelling of the placental lobes, but not sterile ovules in two vertical rows.

[6] The form of these achenes is the chief foundation of the division of the genus into sections as

The genus *Thalictrum* consists of herbaceous perennials found in the cold or temperate regions of Europe,[1] Eastern India,[2] the Cape,[3] and America.[4] The leaves are alternate and several times compound.[5] The petiole, dilated at its base into a kind of sheath with membranous edges, is usually very short and sometimes disappears. In certain cases, as in *T. aquilegifolium* L., we observe small foliaceous expansions or stipels at the base of each of the divisions of the blade. The inflorescence is usually terminal, and consists of a raceme or corymb, with many-flowered cymes for branches. The flowers become here, far more often than in *Clematis*, polygamous or monœcious, or diœcious by abortion, especially in *Euthalictrum* and *Physocarpum*.

Syndesmon, which was made by De Candolle a separate section[6] of the genus *Thalictrum*, and which has been also referred to the genus *Anemone*, is distinguished from the preceding group by the enlargement of its subterranean portion, its few-flowered inflorescence, and the sort of involucre formed by the bracts under the flowers. With De Candolle we shall leave this plant beside *T. tuberosum* L., a closely analogous plant, which possesses the flowers of any other *Thalictrum*, with a solitary suspended ovule and no abortive ones above it,[7] contrary to what happens in *Anemone*.

Actæa[8] has nearly all the essential characters of *Thalictrum*. Thus *Actæa Cimicifuga* L. (figs. 101, 102), which has been again made the type of a special genus,[9] has the habit, the foliage, the

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established by De Candolle (*Syst.*, i. 169; *Prodr.*, i. 11). In *Euthalictrum* the ovules are oval-oblong, with vertical, projecting edges. In *Physocarpum* (*Physocarpidium* Reichb., *Conspect.*, 192) the achenes are stipitate and triquetrous, with the angles winged.

[1] Gren. & Godr., *Fl. Fr.*, i. 4.—Reichb., *Icon.*, iii. t. 26-46.—Koch (*Ann. Sc. Nat.*, sér. 2, ix. 373).—De Massas, *sur les* Thalictrum *de France* (*Ann. Sc. Nat.*, sér. 2, ix. 351).—Regel, *Uebers. der Art. G.* Thalictrum, *welche im Russisch*, &c. (*in Bull. Soc. Nat. Mosc.* (1861), 14).

[2] Hook. & Thoms., *Fl. Ind.*, i. 12.—Boiss., *Diagn. Pl. Or.*—S. & Zucc., *Fl. Jap. Fam.*, 69.

[3] Harv. & Sond., *Fl. Cap.*, i. 3.

[4] A. Gray, *Ill.*, t. 6.

[5] As many as five or six times, according to the species. The leaves closely recal those of most Umbellifers.

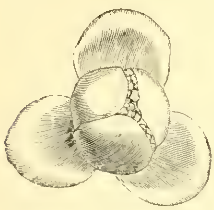
[6] § *grumosa* (*Prodr.*, i. 15).—*Syndesmon* Hoffmansg., *Flora* (1832), *Int. Bl.*, 34.—*Anemonella* Spach, *Suit. à Buff.*, vii. 240.—*Anemone thalictroides* L., *Spec.*, 763.—B. H., *Gen.*, 4. *Thalictrum anemonoides* flore pleno (V. Houtte, *Fl. des Serres*, sér. 2, i. 165).

[7] On *T. Tuberosum*, see J. Gay (*Bull. Soc. Bot. Fr.*, viii. 330).—Above the ovule are only the two vertical, somewhat projecting lips of the carpel. Not the less does this plant show the close affinity of *Thalictrum* and *Anemone*, and only confirms that of the latter with *Clematis*. The flowers appear arranged in cymes, and may be even solitary.

[8] *Actæa* L., *Gen.*, n. 644.—Juss., *Gen.*, 235.—DC., *Prodr.* i. 64.—Spach, *Suit. à Buff.* vii. 275.—Fisch. & Mey., *Anim. Bot.* (*Ann. Sc. Nat.*, sér. 2, iv. 333).—Endl., *Gen.*, n. 4799.—B. H., *Gen.*, 9, n. 27.—Walp., *Rep.*, i. 60; *Ann.*, iv. 32.—H. Bn., *Adansonia*, iv. 54; *Dict. Enc. Sc. Méd.*, i. 665.

[9] *Cimicifuga* L., *Am. Acad.*, viii. 193, t. 4; *Gen.*, n. 1282.—Juss., *Gen.*, 234.—B. H., *Gen.*, 9, n. 28.—Walp., *Rep.*, i. 60; *Ann.*, iv. 32.—*Actinospora* Turcz, *Mss.*, ex Fisch. & Mey., *l. cit.*, 332.—Endl., *Gen.*, n. 4801, 4802.

perianth, the androceum,[1] and the gynæceum of *Thalictrum*. Only the carpels,[2] instead of one ovule, contain an indefinite number[3] in two vertical rows, and become follicles as in the Larkspurs and Columbines. The number of petaloid sepals in this plant varies from four to six (fig. 101), and they are imbricated in a variable



Actæa Cimicifuga.

FIG. 101. Bud.

FIG. 102. Flower without the perianth.

Actæa racemosa.

FIG. 103. Flower without the perianth.

manner.[4] The seeds, like those of the Larkspurs, bristle with small projecting lamellæ. As in *Thalictrum* the carpels are sometimes sessile (e.g. *A. Cimicifuga*), and sometimes supported on a long slender stalk, as happens in *A. podocarpa* DC.[5] Moreover, the number of carpels may also be reduced to one, as happens in the section *Consolida* of *Delphinium*; this may be seen in *A. racemosa* L.[6] (fig. 103), *A. Brachypetala* DC.[7] (fig. 104), and especially in the European species which TOURNEFORT formerly called *Christophoriana*,[8] and which under the name of *A. spicata* (Ang. *Baneberry*, *Herb Christopher*) (figs. 104–109) is often cultivated in our gardens. This has moreover the peculiarity that its pericarp, instead of being dry and dehiscent like a follicle, as it is in the other species, becomes fleshy, and does not open to free the seeds, which are smooth on the

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[1] The stamens are indefinite, and equal or unequal. The filament generally tapers towards its base, and the anther is always two-celled and introrse.

[2] The carpels are always grooved along the whole of the inner border. The ovary is surmounted by a style of very variable length, and sometimes very short.

[3] They always have two coats, and arise one after another, so that the youngest are always uppermost. There are also a few close to the base of the ovary which arise after the others.

[4] With four sepals we usually find two lateral and exterior which overlap one another. The posterior sepal usually overlaps the anterior, but this æstivation is not constant. When, as in *A. spicata*, we have four sepals and only one carpel, its position is not constant, for it is sometimes superposed to one sepal, and sometimes in the interval between two, which is more frequently the case; but even these are not always the same ones.

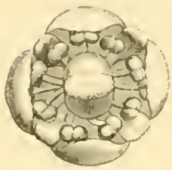
[5] *Prodr.*, i. 64, n. 2.—*Icon. Delesser.*, i. 66.—*Cimicifuga Americana*, L. C. RICH., ap. MICHX., *Am. Bor.*, i. 316.

[6] *Spec.*, 722.—DC., *Prodr.*, 64, n. 5.—*A. monogyna* WALT.—*Cimifuga racemosa* BART.—*Botrophis* RAFIN.—*Macrotys* RAFIN., *N.-York Med. Repos.*, ii., hex. v. 350.—FISCH. & MEY., *l. cit.*, 334.—ENDL., *Gen.*, n. 4800.

[7] *Prodr.*, i. 65, n. 9.

[8] *Instit.* 299, t. 154, "Christophoriana, *quasi planta S. Christophori.*"

surface, and formed like those of the other *Ranunculaceæ* (fig. 109). Like *Clematis* and *Thalictrum*, any of the species of *Actæa* may,



Actæa brachypetala.
Fig. 104.
Flower.

Actæa spicata.
Fig. 105.
Floriferous branch.

Fig. 106.
Flower.

chiefly owing to cultivation, acquire petaloid laminæ of variable size and position,[1] which represent the outer stamens transformed into staminodes (figs. 106, 107). They are herbaceous plants found in the

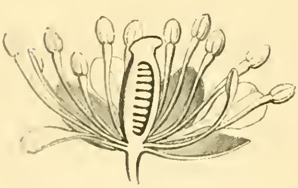


Fig. 107.
Longitudinal section of flower.

Actæa spicata.
Fig. 108.
Fruit.

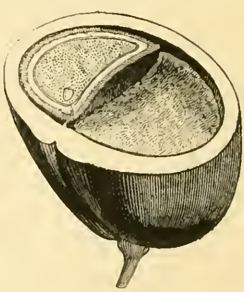


Fig. 109.
Transverse section of fruit.

cold and temperate regions of Europe,[2] Asia,[3] and North America.[4]

[1] In *A. spicata* we may observe four or five petaloid staminodes nearly exactly alternate with the sepals (as in figs. 106, 107), but this position is not constant. We also find nearly complete alternation in the tetramerous flower of *A. brachypetala*, represented in fig. 104. In *Cimicifuga frigida* Wall. and *Actinospora dahurica* Fisch. & Mey., are often seen the whole set of transitional forms between entire petals, bifid petals, and stamens with bifurcated filaments, each branch of which supports an abnormal anther-cell.

[2] Gren. & Godr., *Fl. Fr.*, i. 51.—Reichb., *Icon.*, iv. 121.—H. Bn., *Adansonia*, iv. 54; *Dict. Encycl. Sc. Méd.*, i. 665.—Walp., *Rep.*, i. 10; ii. 738; *Ann.*, i. 5, 953; ii. 5; iv. 9.

[3] Sieb. & Zucc., *Act. Phys. Monac.*, iii. 734, t. 3.—Fisch. & Mey., *Ind. Sem. Hort. Petrop.* (1835), i. 20.—Wall., *Pl. Asiat. rarior.*, t. 129, 264.—Hook. F. & Thoms., *Fl. Ind.*, i. 58.

[4] Hook., *Fl. Bor.-Amer.*, t. 2.—Rafin., *in N.-York Med. Repos.*, ii. v. 350.—A. Gray, *Ill.*, t. 19, 20.

Their subterranean stems are rhizomes analogous to those of the Hellebores. The aerial branches bear alternate leaves like those of *Thalictrum*, slightly sheathing at the base, and either pluripinnate,[1] simply digitate, or even hardly at all lobed in certain Japanese species such as *A. acerina*.[2] The inflorescence is terminal, consisting of more or less elongated simple or compound racemes ; this last character varying in the same species, and even on the same stem. The flowers are nearly always solitary in the axils of the alternate bracts, but may be here and there accompanied by a lateral bud. Towards the summit of the inflorescence the number of stamens may be greatly diminished, and the gynæceum abort, as in the preceding genera; so that some plants of *Actæa* are polygamous.

Thus constituted,[3] the genus *Actæa*, whose relations with *Ranunculus* through *Trautvetteria*, and with the Columbines through *Xanthorhiza* are recognised by every one, has also been placed near the Pæonies by several authors, on account of its multiovulate ovaries, and the form of its leaves.

IV. PÆONY SERIES.

While all the *Ranunculaceæ* we have as yet studied have convex receptacles to their flowers, so that the leaves of the perianth and the stamens have a hypogynous insertion, in the Pæonies[4] the floral receptacle becomes slightly concave, so as to forma kind of cup, the base of which supports the carpels, the calyx, corolla, and stamens are inserted perigynously on its sides. The flowers are hermaphrodite and regular. If we examine one of *P. albiflora* PALL. (fig. 110), we see that the peduncle, dilated above into a fairly deep receptacular cup, bears on its rim a calyx often[5] formed of five free

[1] As much as four or five times divided in *A. racemosa*, *spicata*, &c.

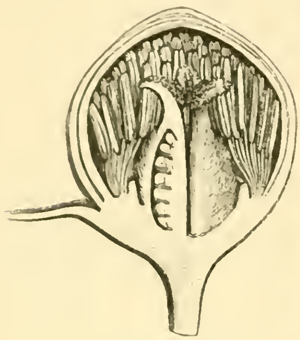
[2] *Pityrosperma* SIEB. & ZUCC. (*Act. Math. Phys. Monac.*, iii. 743, t. 3). Here they are sometimes even simple. In other respects these plants are inseparable from *Macrotys*, of which they possess the perianth, the gynæceum, and usually the unicarpellary ovary. But some flowers of *Pityrosperma* have certainly several carpels.

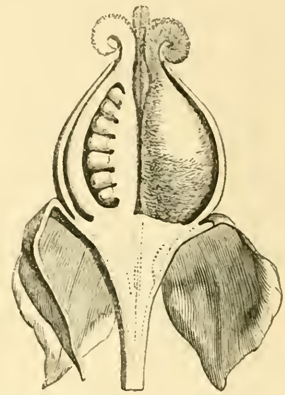
[3] *Actæa.* Sections 4.
1. *Christophoriana* T. One fleshy carpel. Seeds smooth.
2. *Botrophis* RAFIN. One dry carpel. Seeds smooth.
3. *Pityrosperma* SIEB. & ZUCC. One or several dry carpels. Seeds bristly.
4. *Cimicifuga* L. *Actinospora* S. & ZUCC.). Several dry carpels. Seeds bristly.

[4] *Pæonia* T., *Inst.*, 273, t. 145.—L., *Gen.*, n 678.—JUSS., *Gen.*, 234.—DC., *Prodr.*, i. 65.—SPACH, *Suit. à Buff.*, vii. 394.—ENDL., *Gen.*, n. 4804.—B. H., *Gen.*, 10, n. 30.—H. BN., *Adansonia*, iii. 45 ; iv. 56.

[5] It is in theory alone that we admit that there are only five sepals, and consider as bracts the outer appendages, which resemble the foliage-leaves more or less. (See *Adansonia*, iv. 3.)

dissimilar[1] sepals, quincuncially imbricated in the bud. The petals, equally free and imbricated in the bud, have a short claw, and are





Pæonia albiflora. *Pæonia Moutan (papaveracea).*

FIG. 110. Longitudinal section of bud.

FIG. 111. Disk and gynæceum.

FIG. 112. Longitudinal section.

often equal in number[2] to the sepals, and alternate with them.[3] The stamens are very numerous, inserted along a spiral of many turns very close to one another. The anthers,[4] two-celled and introrse, are narrow and elongated, each dehiscing by two longitudinal clefts.[5] The somewhat unequal filaments, attached to the bases of the anthers, are free, slender,[6] and inserted without the projecting rim formed by a glandular disk which lines the concavity of the receptacle, and projects more or less from it. Here it is only a small, unequally crenulate ledge, while in other species, such as *T. papaveracea* ANDR.[7] (figs. 111, 112), this disk rises up into a coloured sac, which looks as if formed by a union of appendicular organs, and entirely surrounds the ovaries, only giving passage to the styles by the narrow aperture at its summit.[8] The gynæceum consists of a variable

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[1] The more internal they are the more they resemble petals in form and consistency; the more external they are the more they resemble bracts.

[2] Except in cases of deduplication.

[3] With five petals the æstivation is sometimes quincuncial; but more often there is only one of the petals quite inside, and only one entirely overlapping. They are very caducous.

[4] A transverse section of the anther shows that it is divided by four longitudinal grooves into as many nearly equal lobes, two to each cell. The anther has really but two cells. It is very decidedly introrse in *P. arietina, Wittmanniana,* and much less so in *P. officinalis, mollis,* &c.

[5] Moreover, after dehiscence the anthers become twisted on themselves or revolute from above downwards.

[6] The filaments are shorter as they are more external. The weight of the anthers makes them droop after the expansion of the flower.

[7] This is rather a mere variety of *P. Moutan,* SIMS, with white petals spotted with purple, and a much developed disk (ANDR., ex DC., *Prodr.,* i. 65).

[8] Whatever be its size, this organ is like a disk, late to develope. When it nearly surrounds

number of free carpels,[1] each composed of a unilocular ovary tapering above into a style; the inner face of this is traversed by a longitudinal groove, with thick everted margins covered with stigmatic papillæ. In the inner angle of the ovary is a vertical placenta, supporting two rows of nearly horizontal anatropous ovules,[2] placed back to back. The fruit is formed of as many follicles, surrounded by the persistent calyx, and dehiscing along the inner angle (fig. 113) to free the large seeds (fig. 114), each of which contains an embryo surrounded by fleshy albumen, and has its funicle dilated around the hilum to form a fleshy aril of no great size.[3]

Pæonia Moutan.
FIG. 113.
Fruit opened.

Pæonia peregrina.
FIG. 114.
Seed.

Instead of a pentamerous quincuncial corolla, the Pæonies have sometimes two corollas each formed of three petals, of which the outer ones alternate with the three inner petals, and the inner ones alternate with the outer. This is constant in *P. Wittmanniana* STEV.,[4] a species in which the corolla is yellow, instead of being white or red, like that of the other Pæonies, and which may be made the type, not of a distinct genus, but of a section[5] which is to the true Pæonies what *Hepatica* is to *Anemone*, or *Ficaria* to *Ranunculus*. The organization is in other respects similar; and in this species, as in all the others, the number of petals may become much greater still, owing to deduplication, which affects the inner petals in preference to the outer ones, or to the metamorphosis of the outer stamens, as happens in double flowers.

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the gynæceum the carpels, which were at first near one another, diverge from the centre of the flower before dehiscing separately, and tear this disk more or less irregularly from above downwards.

[1] When there are five or six they are usually opposite the five or six innermost leaves of the calyx. The number three is equally common, and in *P. Wittmanniana*, where it is the rule, the three carpels are opposite the three innermost sepals. In the cultivated varieties of *P. Moutan*, we see as many as fifteen or twenty carpels, often sterile, grouped into a head like those of a *Ranunculus*. There are two carpels pretty often, but very rarely only one.

[2] These ovules have two coats. The outer one forms at first a sort of hood with a large opening externally. The short, thick, conical funicle swells early to begin the formation of the aril. At first the youngest ovules are on the upper part of the placenta, and often (but not always) right down at its base also. Hence the evolution of the ovules commences towards the base of the ovary, or at least below its middle.

[3] But the existence of which is, however, incontestible and constant, although the *Ranunculaceæ* have been usually considered to want arils entirely.

[4] STEVEN (*Ann. Sc. Nat.*, sér. 3, xii. 374).—WALP., *Ann.*, ii. 14.

[5] *Tripæonia* H. BN., *Adansonia*, *l. cit.*

The Pæonies are most usually herbaceous perennials, with a thick stock giving off aerial branches, bearing dissected or pluripinnate leaves, and ending in large flowers, under which are seen a number of bracts, arranged in one continuous spiral with the leaves and sepals, and intermediate between them in form.[1] *P. Moutan* SIMS,[2] a Chinese species, forms of which have been multiplied by cultivation, and which has been made the type of a distinct section[3] and even genus,[4] differs from the others by its shrubby stems. It is in this species, too, that the disk, becoming greatly developed, surrounds the gynæceum almost entirely. The herbaceous Pæonies[5] grow in the northern hemisphere, in Europe, Asia,[6] and America.[7]

We have replaced near the Pæonies,[8] not without doubt, *Crossosoma*[9] which some authors rank among the *Dilleniaceæ*;[10] and this we have done because we lay more stress on their perigynous insertion than on the persistence of the calyx[11] and the presence of an aril.[12] The receptacle[13] is a deep cup-shaped cavity which bears on its margins five sepals and five petals alternate with them (both imbricated in the bud), with a large number of free perigynous stamens. The filament is slender and filiform; the oblong anther has two cells which dehisce marginally by two longitudinal clefts.[14] In the bottom of the receptacle are inserted the free carpels, varying

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[1] All these leaves which surround the perianth have an angular divergence of $\frac{2}{5}$; and, as we have said, it is really impossible to decide where the sepals end and the bracts begin, just as we have no sharp demarcation between these latter and the true leaves. Thus in *P. lobata* DESF., there are five concave quite entire orbicular sepals. To these the carpels are superposed when of the same number. More externally are two narrow lanceolate leaves, while between these and the five rounded sepals is a leaf which is intermediate alike in position and in form, for it is acutely oval. In the flowers of *P. tenuifolia* L., the bracts, like the leaves, are more or less laciniate, and so is still sepal 1; while sepals 4 and 5 are entire and rounded. Analogous facts are seen in *P. officinalis, corallina, Moutan*, &c.

[2] *Bot. Mag.*, t. 1154.—DC., *Prodr.*, i. 65, n. 1.

[3] Sect. i. *Moutan* DC., *l. cit.*

[4] LINDLEY, ex B. H., *l. cit.* The same author has made a section *Onæpia* (*Veg. Kingd.*, 428).

[5] Sect. ii., *Pæon.*, DC., *l. cit.* (*Eupæonia* H.BN., *l. cit.*).

[6] GREN. & GODR., *Fl. Fr.*, i. 52.—REICHB., *Icon.*, 122-128.—KOCH (*Ann. Sc. Nat.*, sér. 2, iii., 371).—BOISS., *Diagn. Pl. Orient.*—HOOK. & TH., *Fl. Ind.*, i. 60.—S. & ZUCC., *Fl. Jap. Fam.*, 76.—WALP., *Rep.*, i. 61; ii. 745; v. 7; *Ann.*, i. 14; ii. 4; iv. 30.

[7] C. GAY, *Fl. Chil.*, i. 56.

[8] *Adansonia*, iii. 47; iv. 57.

[9] NUTT., *Pl. Gamb.* (*Journ. Ac. Philad.*, ser. 2, i. 150).—TORREY, *Exp. Wipple. Bot.*, t. 1.—B. H., *Gen.*, 15, n. 17.

[10] BENTHAM & HOOKER say of this genus (*l. cit.*), comparing it to the Pæonies, "*Differt sepalis persistentibus et seminibus arillatis* Dilleniacearum." Now it so happens that both these characters exist in both genera, though in different degrees.

[11] The calyx persists in *Crossosoma* and most Pæonies.

[12] The Pæonies have a short aril, no matter by what name we call it.

[13] Most authors consider this receptacle as a tube formed by the base of the sepals; but the insertion of the stamens proves that we have here to do with the same organ as that which occupies the base of the flower in *Rosaceæ*.

[14] Moreover, after dehiscence the anthers become spirally rolled on themselves, as in some of the Pæonies.

in number[1] like those of the Pæonies. Each consists of a one-celled ovary, tapering into a short style, which swells at the tip into an oblique discoid stigmatiferous head. In the inner angle of the ovary is a double placentary cord, bearing in two parallel rows the indefinite, horizontal, anatropous ovules, each having a little ciliated frill round its hilum. This becomes an aril with long filaments around the reniform seed,[2] which contains within its thick coats a curved, fleshy albumen surrounding the embryo. The fruit is dry and dehiscent.[3] *C. californica*, the only known species, is a small branching shrub,[4] with alternate, simple, obovate-oblong leaves tapering at the base, with a short petiole and a penniveined blade. The flowers are solitary and terminal.

Now alone, after all the genera of this family are known to us, are we qualified to study its general characters. Some are constant: in all the genera studied, we have observed that albumen is always present surrounding the embryo; that the ovule is entirely or incompletely anatropous; that the pieces of the perianth and of the androceum are free from all adhesion; and that the number of stamens is never strictly defined.[5]

Other characters, not absolutely constant, are very frequently observed, and have therefore great value. Such are: the alternation of the leaves;[6] the absence of stipules;[7] the spiral arrangement of the parts of the flower;[8] the independence of the carpels; the convex form of the floral receptacle; and hence the hypogynous insertion of the exterior whorls.[9]

Others, finally, are essentially variable, and hence can only serve to distinguish altogether secondary groups. These are: the persistence of the pieces of the perianth around the fruit,[10] and the

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[1] There are said to be from three to five.

[2] These seeds recal in their conformation those of several *Menispermaceæ*—among others the *Indian Berry* (Fr. *Coque du Levant*).

[3] Separating, it is said, into two valves.

[4] The bark of the branches is said to be very bitter; and the dry leaves are slightly so,—a character which, joined to some others, suggests affinities between it and the *Simarubaceæ*. *Multis notis* Simarubaceis *convenit, sed recedit staminibus* ∞, *ovulo, et arillo* (BENTH. & HOOK., *l. cit.*).

[5] Characters which by themselves have no taxonomic value, being found in many families.

[6] The genus *Clematis* is the only exception.

[7] There are petioles with dilated bases which, by their lateral wings, come very near to true stipules. Generally the *Ranunculaceæ* are without stipules, but it is difficult to refuse the name to the lamellæ seen at the bases of the leaves of *Thalictrum*, *Isopyrum*, &c., and especially of the floral leaves of the latter.

[8] In the Columbines there appear to be true verticils; but the rays of stamens are perhaps only very conspicuous secondary spirals, vertical or nearly so.

[9] The Pæonies and *Crossosoma* are alone perigynous.

[10] Considerable value has been attached to this character, which it has been said distinguishes this order from *Dilleniaceæ*. We give it hardly any, as we have said several times. We know,

regularity or irregularity of their form;[1] the absolute number of them in each verticil, or pseudo-verticil, and the number of these verticils themselves;[2] the aspect of the anther;[3] the number of carpels, and the number of ovules in each; the direction of these ovules[4] and of the seeds; the consistency of the pericarp.[5]

To LINNÆUS is due the first foundation of this family. BERNARD DE JUSSIEU, in his arrangement of the garden of the Trianon,[6] only borrowed from the author of the "*Fragmenta Botanica*," and A. L. DE JUSSIEU[7] simply reproduced the work of his uncle, adding to his *Ranunculi* the genus *Podophyllum*, whose right to a place in this group has been much disputed, besides four small genera of little importance.[8] ADANSON has been accused of having destroyed the homogeneity of this group in his great work,[9] by adding the greater number of the *Alismaceæ*. We have said elsewhere,[10] and we repeat it, that this course appears to us thoroughly rational. As arranged in JUSSIEU'S "*Genera Plantarum*" the *Ranunculaceæ* include[11] twenty-three genera, studied by A. L. DE JUSSIEU himself in several detached memoirs,[12] and after him by most of his successors, with peculiar predilection and attention, as representing on the whole a group of vegetables fittest to afford types for the most important principles of taxonomy.[13]

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for example, that in the two sections established in the genus *Caltha*, the one has persistent, the other caducous sepals, &c. (See *Adansonia*, iv. 36).

[1] Describers have usually confused the irregularity of the corolla, and that of the individual sepals or petals. Sepals of very strange form, helmet-shaped or spurred, may be very regular. On the other hand spurless sepals may be truly irregular, their halves being unsymmetrical (*op. cit.*, iv. 9).

[2] The proof that the number of verticils has no importance is the facility with which in the *Pæonia, Anemone*, &c., we pass from one quincuncial verticil to two alternately trimerous verticils (see pp. 37, 42, 61).

[3] Till the time of DE CANDOLLE it was believed that the *Ranunculaceæ* had their anthers generally extrorse, and the *Dilleniaceæ* had them introrse. A. DE St. HILAIRE was the first to rectify this error (see *Adansonia*, iv. 14, note). There are far more *Ranunculaceæ* with introrse anthers than has been generally allowed. *Nigella, Delphinium, Eranthis*, &c., described as having extrorse anthers, have them decidedly introrse.

[4] *Callianthemum* is the only Ranunculad with a pendulous ovule and the micropyle *exterior*. Otherwise every ascending ovule has its micropyle exterior, and every descending ovule has it interior. We shall see that if the *Dilleniaceæ* had a descending ovule it would be like that of *Callianthemum*; but when the ovules are few in number, they are ascending.

[5] We have not attached much importance to this character. Can a thoroughly ripe Almond with its pericarp quite dry, be separated generically from a Peach with its mesocarp succulent? We think not, and we would here recal the instance of the Adonids where the fruit, to-day a drupe, will be to-morrow an achene. We have been unable to found generic divisions on this character.

[6] *In* A. L. DE JUSSIEU, *Gen.*, lxviii.

[7] *Genera Plantarum, sec. ord. nat. dispos.* (1789), 231.

[8] *Hydrastis, Hamadryas, Xanthorhiza, Cimicifuga.*

[9] *Familles des Plantes* (1763), ii. 451.

[10] *Adansonia*, iv. 40.

[11] Not counting *Podophyllum*, with which we are not now concerned.

[12] Chiefly in that which he points out himself (*op. cit.*, 235): "*Apta generum signis numerosis affinium conjunctio ac dispositio jam in Act. Acad. Paris.* 1773, *statuta.*"

[13] We have seen that on the other hand several authors consider this family as being of a low

Of the genera admitted by Jussieu, Salisbury separated *Knowltonia* (p. 47), *Eranthis* (p. 15), and *Coptis* (p. 17) as distinct generic types. So the authors of the "*Flora Altaica*" established the genera *Callianthemum* (p. 48) and *Oxygraphis* (p. 37). De Candolle had already referred *Atragene* to *Clematis* and *Cimicifuga* to *Actæa*; but he admitted as distinct genera the families *Tetractis* of Sprengel, *Hepatica*, and probably too, the *Enemion* of Rafinesque (p. 19). Hence the "*Prodromus*" enumerates twenty-eight genera of *Ranunculaceæ*. Siebold & Zuccarini added the two Japanese genera, *Anemonopsis* (p. 22), and *Glaucidium* (p. 23); Hooker & Thompson inserted the Indian *Calathodes* (p. 21); and to Nuttall is due the genus *Crossosoma* (p. 62), whose claims to a place in *Ranunculaceæ* are somewhat doubtful. In fine, as many as sixty distinct genera have been admitted into this order; we have reduced their number to nineteen.[1]

Thus established by so many labours following one after another for the last century, this family of plants is one of those which B. de Mirbel so happily termed "*familles par enchainement*." The genera follow one another, and that closely; but they are not closely grouped round a common centre. Accordingly the variability of the characters has allowed various authors to establish secondary divisions in the group. In the first place Adanson[2] distinguishes two sections; the first with many-seeded, the second with one-seeded capsules. A. L. de Jussieu[3] established four sections; his first answers to Adanson's first; Adanson's second section is divided into two, according as the petals (not the corolla) are regular or irregular; the *Acteæ* with a single polyspermous carpel constitute the fourth section. De Candolle[4] divides the Ranunculaceæ into five tribes; the first (*Clematideæ*) is marked chiefly by its valvate induplicate æstivation and opposite leaves; the second (*Anemoneæ*) is

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organization (see p. 45, note 1), and that organs elsewhere distinct are here often assimilated, degenerated, and passing easily into one another.

[1] It must be borne in mind that we do not pretend to impose either these genera that we admit, or the limits we assign for them, as absolute. In short when once the common and the differential characteristics of two groups of plants are known, it matters but little whether we separate them as distinct genera, or unite them as sections of a single family. Here custom is all-powerful. People hesitate to regard as entirely identical what have been regarded by every one since Linnæus as distinct generic terms; but in the present state of confusion of our science it seems to us advantageous to diminish the number of generic divisions as far as possible.

[2] *Op. cit.*, 457, 459.

[3] *Op. cit.*; 1, *Capsulæ monospermæ non dehiscentes*; 2, *Capsulæ polyspermæ—Petala irregularia*; 3, *Capsulæ polyspermæ—Petala regularia*; 4, *Germen unicum. Bacca unilocularis polysperma.*

[4] *Syst.*, i. 127; *Prodr.* (1824), i. 2-66.

especially remarkable for its imbricated æstivation—a character met with in the rest of the order; but in the third tribe (*Ranunculaceæ*) the seed is erect, not pendulous, and the petals are bilabiate, or provided with a small basilar scale; the *Helleboreæ*, which constitute the fourth tribe, have polyspermous carpels; and the fifth (*Pæonieæ*) especially characterized by the introrse anthers, is considered as, perhaps more properly, a distinct order. ENDLICHER,[1] and BENTHAM & HOOKER[2] accept DE CANDOLLE's tribes without alteration. LINDLEY[3] slightly modified them by uniting the Pæonies to the *Helleboreæ* and putting *Xanthorhiza* into a special section with the *Acteæ*. These different classifications are of more or less service practically; but we have not retained them, as they rest on the absolute value of characters which are not constant. The opposition of the leaves in *Clematis* is a character easily observed, but of no great absolute worth, as many other genera exist of which some species may have alternate and others opposite leaves.

The æstivation would appear a completely satisfactory character if it were not that at a certain stage in the life of *Clematis* the perianth may become imbricated like that of a *Ranunculus*.[4] The absolute number of the ovules would have some value if we were not now aware that *Clematis, Anemone, Adonis*, have all really five ovules instead of one;[5] while in *Isopyrum* we may have some carpels with several, and others with only one.[6] The direction of the ovule, whether ascending or descending, is not more absolute as a distinction, for in *Adonis* alone we may observe instances of both.[7] As to the introrse or extrorse aspect of the anther, it has long lost much of its value; and if the *Acteæ*, which we put near the Pæonies, like them have their anthers generally introrse, in some they are extrorse;[8] and so they are undoubtedly in many *Ranunculaceæ* with multiovulate carpels, as the Larkspurs, Aconites, *Nigellæ*, &c. Hence in our essay to group the *Ranunculaceæ*, we have been unable to recognise the *absolute worth* or the subordination of characters. We have been compelled to admit and to combine the greatest possible

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[1] *Genera Plantarum, sec. ord. nat. dispos.* (1836-40), 843, Ordo clxxviii.

[2] *Genera Plantarum, ad Exempl. impr. in Herb. Kewens. Def.*, i. (1862), 1-10.

[3] *Vegetable Kingdom* (1846), 425, Ord. cliv.

[4] See p. 50, note 4, and *Adansonia*, iv. 55.

[5] See p. 41, fig. 76, p. 46 & p. 51.

[6] See p. 48, note 3.

[7] See *Adansonia*, ii. 209.

[8] In some flowers of *Cimicifuga frigida* WALL., the anthers are clearly introrse.

number of very different characters, and to group those genera that we retain around a few well-marked centres which they approach more or less closely. Hence certain genera happen to be on the peripheral limits of two or more groups at once, and indicate by what features these groups are bound together. Or, indeed, if we draw up each of these groups in a line, with the typical species at the head, we obtain a certain number of series which are parallel or nearly so for some part of their course, but afterwards diverge in various directions, and hence must intersect, their intersections indicating the characters common to the different sections.[1] The prototypes that we have chosen provisionally[2] are *Aquilegia*, *Ranunculus*, *Clematis*, and *Pæonia*, from which we afterwards derive the other genera by the modifications found in the number and direction of the ovules, the number of pieces and whorls in the perianth, the symmetry and æstivation of the flower, the position of the leaves, &c.

The *Ranunculaceæ* are almost always herbs, far more rarely annuals than perennials. In the latter case we have seen how they are propagated in the different genera by buds, nourished while developing by the accumulation of juices, either in their own bases, or in those of the neighbouring organs.[3] The herbaceous stems usually possess a normal or nearly normal organization. The pith of branches which grow fast sometimes contracts so as to render them more or less fistular.[4] In several of these same species the fibro-vascular bundles, dispersed with little apparent order through the cellular mass, have the same distribution as in the stems of Monocotyledons, and the medullary rays may lose their usual rectilinear course so as to render doubtful their existence.[5] These fibro-vascular bundles (often numerous in herbaceous stems that have

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[1] Thus we have shown (*Adansonia*, iv. 41), how *Ficaria*, by its close analogy to *Caltha*, connects *Trollius* and *Ranunculus*; how the Hellebores, closely allied to *Trollius*, lead back to the *Nigellæ* which are Columbines with deduplicated nectaries. *Trautvetteria* is allied by its habit to *Actæa* and *Thalictrum*, by its flower to *Ranunculus*. *Thalictrum*, only separated from *Actæa* by the lesser number of its ovules, is at the same time closely allied to the Anemones by *Syndesmon*, and *Xanthorhiza*, formerly left unseparated from *Actæa* and *Pæonia* is, says PAYER, merely *Aquilegia* with but few staminal whorls.

[2] From what we have stated before it will be seen that *Clematis* and *Anemone* only differ in the præfloration of the calyx; and so purely provisional is the grouping we propose, that we have already said (*Adansonia*, iv. 55) that instead of keeping the *Clematis* series distinct, we should perhaps do better in joining it to that of the Anemones. In fact we have seen (pp. 50, 51) that at a given moment the æstivation of a *Clematis* may become that of *Anemone*.

[3] See pp. 5, 31, 38.

[4] In several aquatic species of *Ranunculus* *Delphinium*, *Aconitum*, *Anemone*, *Thalictrum* (on these last, see DE GERNET, *Xylologische Studien*, *Bull. Soc. Mosc.*, 1861, 423).

[5] HARTIG, *Beitr. z. Vergl. Anat. der Holzpfl.* (*Bot. Zeit.* (1859), 93, 96).

lived but a few months)[1] are usually better developed as they approach the centre of the stem. In the Hellebores[2] and Anemones,[3] the bundles, though of different ages, may form an apparently single circle round a voluminous pith. In several herbaceous species has been especially described the layer of cells called "*protective sheath*."[4] The axes of *Ranunculaceæ* are often, too, remarkable for the poverty of their tracheal system. Moreover, a certain number of plants have always been pointed out in this order as exceptional in the consistency of the stem and branches being woody to a certain extent; these are chiefly the so-called "Tree-Pæonies," *Xanthorhiza*, and *Clematis*. The woody portion of the stem of *Pæonia Moutan* presents hardly anything peculiar in its anatomy. The thick pith is surrounded by a fresh ring of wood each season. The liber is, on the contrary, very scanty, and the outer cellular layers of the bark are the seat of slow and ill-marked exfoliation, much better seen in *Xanthorhiza*, and still better in *Clematis*. In the former, beneath many layers covering one another with great regularity, and in old branches alternately white and brownish—that is, dead and ready to peel off—may be seen a layer of moniliform appearance, made up of cells, and gorged with a limpid yellow colouring matter.[5] This structure, which is essentially constant, assumes a high degree of distinctness and regularity in *Clematis*, because the leaves are opposed, or verticillate; and it has here attracted the attention of very many observers.[6] In the hexagonal stem of *Clematis* may be seen a pith of no great thickness, surrounded first by six, and then by ten, fibro-vascular woody

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[1] In the herbaceous shoots of Larkspurs a month old we may find them of three, four, or five successive ages.

[2] LINK, *Icon. Bot. Anat.* (1857), ii. xi. 1, 5. —I. DUMAS, *op. cit.*, 5-23, t. 1, 2.— In *H. fœtidus* the pith is enormous, formed of cells arranged in rows in every direction, so as to form a network of beaded fibres separated by irregular passages. The fibro-vascular bundles in a shoot of a single season are numerous; they are remarkable for having the whitish woody fibres surrounding the vessels on the sides as well as external to them. The peduncle of *H. niger* has the same fundamental organization. The sub-epidermic cortical cells are often gorged with pink colouring matter.

[3] VAUPELL, *C. üb. d. periph. Wachsthum d. Gefäsbund.* (1855), 21, t. 1.—The arrangement of the bundles in the *Anemones* is fundamentally the same as in the annual Larkspurs.

[4] CASPARY, in *Pringsheim's Jahrbuch.* (1864), iv. 101.

[5] This yellow liquid is found in the young wood, though of a paler tint. The liber of little thickness, is incompletely divided into as many closely packed segments, as there are sectors of the wood (whose compact fibres are minutely punctate), separated by the medullary rays. The cells of the pith are also punctate.

[6] HUNDESHAGEN, ex MOHL (*Ann. Sc. Nat.*, sér. 2, ix. 295).—DUTROCHET, *Accroiss. des. Végét.* (*Mém. Mus.* (1821), vii. 397, t. 15, f. 4-7).— GIROU DE BUZAREINGUES (*Ann. Sc. Nat.*, sér. 1, xxx. t. 7, figs. 3, 4; sér. 2, 1, 159, t. 5, fig. 1).—SCHLEIDEN, *Grundzüge d. Wiss. Bot.* ii. 160, fig. 145.—QUEKETT, *Histol.* 84.— CARPENTER, *Microsc.* (1856), 431, 440 (? ex OLIV.).—GRIFFITH & HENFREY, *Microgr. Dict.* (1856), 75, 387, 689.—A. GUILLARD (*Ann. Sc. Nat.*, sér. 3, viii. t. xvi.).

bundles, separated from one another by as many medullary rays, which are continued into the cortical parenchyma. When adult, only a single layer of liber envelopes this wood, all the rest of the bark having fallen, or else there are a certain number of plates of liber, crescent-shaped in transverse section, more or less ready to fall, owing to the development of a layer of cells on the inner side. Hence it is only when young that there are outside the bark an epidermis and a parenchyma, whose cells have green contents. Later on, the exfoliated branches of most of the genus only present bundles of fibres on the surface, separated from one another by the peripheral edges of the medullary rays.[1]

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[1] The evolution of these stems should be studied closely and in detail from a histological point of view. In a young hexagonal axis (the sides may increase in number when the leaves become verticillate) we only see a nearly homogeneous tissue within a hairy epidermis. Later on appear six equidistant fibro-vascular bundles, each in two parts; the one, fibro-vascular, belongs to the wood; the other, which represents the cortical fibres, is at some distance from the former, from which it is separated by a thick zone of formative cells. The six medullary rays are also very large, and in the thickness of each of these we see formed a little later a younger fibro-vascular bundle. This set of bundles alternate with the first and afterwards grow so as to have equal, or nearly equal dimensions, with them. When the twelve bundles have come into contact with, and compressed one another, and are all triangular in horizontal section, the wood presents twelve linear medullary rays, separating them from one another. The twelve bundles of cortical fibres increase so that the transverse section of each of them soon becomes a crescent with its convexity outwards. The formative zone is then represented, not by a ring, but by twelve cellular crescents, moulded in the concavity of the fibrous crescents. Still later, fibres appear within this cellular crescent, also arranged in an arc concentric with the preceding (besides the fact well established by GIROU DE BUZAREINGUES, of deduplication from without inwards, two fibrous crescents forming within each of those of the first generation, two again within each of the second generation, and so on). Thus we have in each segment of the transverse section two fibrous concentric arcs, separated by a cellular crescent. It is here that the separation takes place; the cells wither and leave the inner crescent, while still adhering to the outer crescent which they bring with them. Such is the cause of the exfoliation. We should add that under the epidermis, along the projecting angles of the stem, the cortical cellular tissue undergoes a different transformation into elongated elements with whitish thickened walls. These outer bundles also fall later on, with the detached fibres of the bark. The same exfoliation occurs in *Pæonia* and *Xanthoriza*, but it is less evident because of the number and small size of the bundles, which appear to have a less regular arrangement in transverse section, on account of the leaves being alternate. In the *Nigellæ* with sulcate stems (and especially in *Garidella*), in *Thalictrum*, in certain Aconites (especially the sarmentose species), the fibro-vascular bundles of the wood and bark are similarly organized, and in *Garidella* are distinctly seen the projecting angles under the epidermis where the outer tissue of the bark also becomes thickened, elongated, and fibroid. Often in these plants the cortical fibrous portion of each bundle begins to separate from the deep parts; the death of the branch stops the exfoliation. In several species of *Clematis* also, with herbaceous annual branches, like *C. tubulosa*, the exfoliation has not time to appear. In the young branches of *C. montana*, which die in our country after their season of vegetation, there is no exfoliation of the bark, and the bundles touch and are united into a sort of ring in the cortical portion, so that the liber on the whole, nearly assumes the tubular form it presents in most woody plants. In some species (in this respect intermediate), the fibrous crescents of the bark are much multiplied before the occurrence of desquamation, as are the cellular crescents which line them; we then see at the same time very many of these little arches differing greatly in age, of which the outer ones alone (which are very old) commence to separate from the younger ones. H. MOHL called attention to the fact that the cells of the prosenchyma in *Clematis* are shorter than is usually thought, being only from $\frac{4}{10}'''$ to $\frac{8}{10}'''$ (*Ann. Sc. Nat.*, sér. 4, v. 144.)

Affinities.—B. de Jussieu placed *Ranunculi* between *Capparideæ*, and *Lauri*. Adanson put them between his group "*Arum*" and that of the Cistuses, which included *Curatella*, *Sarracenia*, and *Nigella*. A. L. de Jussieu makes them the first order of his Polypetalous Hypogynous Dicotyledons, and puts *Papaveraceæ* next. De Candolle, whose example has been followed by very many authors, begins his enumeration of Thalamifloral Polypetalous plants by *Ranunculaceæ*, before *Dilleniaceæ* and *Magnoliaceæ*. Endlicher intercalates them between *Dilleniaceæ* and *Berberidaceæ* in his class *Polycarpicæ*. Lindley[1] gives their name to his thirty-second Alliance "*Ranales*" where they are placed between *Dilleniaceæ* and *Sarraceniaceæ*. Brongniart[2] gave them exactly the same position: in the Botanical School of the Museum they are actually interposed between *Dilleniaceæ* and *Nymphæaceæ*. J. G. Agardh[3] divides them into three families (*Helleboreæ*, *Nigellaceæ*, and *Ranunculeæ*), which he puts between *Podophylleæ* and *Adoxeæ*. We cannot, indeed, doubt their close relationship to the *Polycarpicæ* (*i.e.*, *Magnoliaceæ*, *Schizandreæ*, *Anonaceæ*, *Menispermaceæ*, &c.). Finally, except for the centripetal evolution of the stamens (invisible when the flower is full grown), no absolute character separates them from the *Dilleniaceæ*, which may be considered as the *Ranunculaceæ* of hot climates, usually with woody stems. The herbaceous genus *Acrotrema* is the only exception, and approaches *Ranunculus* as nearly as possible. We have attempted to show[4] that *Ranunculaceæ* and *Dilleniaceæ* do not differ absolutely in any of the characters previously used to distinguish them—the persistence of the calyx; the aspect of the anthers; the direction of the ovules and of their parts; the existence of an aril—only that the stem is more frequently herbaceous in *Ranunculaceæ* than in *Dilleniaceæ*, while these rarely want an aril, the existence of which is, on the contrary, exceptional and not well marked in the former. The calyx is said to persist always in *Dilleniaceæ*; it is oftener caducous in *Ranunculaceæ*. As to the direction of the ovules, "there is but one Ranunculad with a suspended ovule and the micropyle external when adult, and this situation of the micropyle would be seen in *Dilleniaceæ*, if the ovule were suspended, since it is

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[1] *Op. cit.*, 416.

[2] *Enumeration des genres de plant. cult. au Mus.*. (1843), 96, Fam. 193.

[3] *Theoria Systematis Plantarum* (1858), 76, 77, 78, t. v., figs. 11-13. "Ranunculaceas . . . *exhibui, ut relationem cum* Adoxa *evidentiorem redderem.*"

[4] *Adansonia*, iv. 36.

internal in the ascending ovule. However, no Dilleniad has yet been observed in which the ovule, if solitary, is not ascending."

The *Ranunculaceæ* are also closely allied to *Berberidaceæ*, through *Podophyllum* and *Jeffersonia*. This last being also related to *Papaveraceæ* by *Sanguinaria*, the *Ranunculaceæ* come very near the *Papaveraceæ*, of which the organization of the pistil is alone different. But we have shown[1] that, in spite of this difference, which is not really great, we ought not logically to put *Papaveraceæ* and *Ranunculaceæ* in distinct orders, while we do not separate *Monodora* from the *Anonaceæ*, or *Berberidopsis* from *Lardizabalaceæ*. We have also said[2] that the *Alismaceæ* approach the *Ranunculaceæ* in every way, for certain species of Alisma differ from some of the aquatic *Ranunculaceæ* in only one respect—the number of cotyledons in the embryo. In our opinion, the conjunction of these two types, due to ADANSON's sagacity, "is most consonant with natural methods."

Finally, the *Rosaceæ*, chiefly through *Potentilla*, come far nearer the *Ranunculaceæ* than is usually admitted. The insertion, a character the value of which has been exaggerated, no longer separates the two groups so clearly, since some of the *Ranunculaceæ* have been demonstrated to be perigynous.[3] The absence of albumen in the *Rosaceæ* appears, on the contrary, to be a constant differentiating character up till the present date.

In fine, the relations of the *Ranunculaceæ* are multiple; and if we tried to represent them by arranging the different families allied to this on a sort of map, we should have to put the *Ranunculaceæ* in the centre, so that its frontiers would touch the *Dilleniaceæ* by *Acrotrema*, the *Berberidaceæ* by *Podophyllum*, the *Magnoliaceæ* by *Myosurus*, the *Illicieæ* by *Knowltonia*, the *Rosaceæ* by *Pæonia* and *Crossosoma*, the *Papaveraceæ* by *Glaucidium*, and *Alismaceæ* by the aquatic *Ranunculi*.

We have to some extent indicated the geographical distribution[4]

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[1] *Adansonia*, iv. 39.

[2] See p. 64. A. L. DE JUSSIEU (*op. cit.*, 235), also recalled these relations.

[3] It is quite certain that the perigyny of the Pæonies is not well marked; else it would have been recognised long ago. But the concavity of the receptable is not more marked in several *Rosaceæ*. (See *Adansonia*, iii. 46.) *Crossosoma*, whose place it is true is somewhat contestible, is very clearly perigynous.

[4] See generally for all concerning geographical distribution DE CANDOLLE's *Géographie Bot. Rais.* (1855); and for European species, especially those of the central plateau of France, see LECOQ, *Ét. sur la Géog. Bot.*, iv. 102-525 (1855).

of the *Ranunculaceæ* after each genus we have studied. Turning now to general considerations, we shall first state these two great facts: there is hardly any country in the world in which at least a few of these plants are not to be found; they are the less abundant in any country in proportion to other orders as the temperature of that country is higher. Hence the nearer a country is to the tropical zone, the worse are the *Ranunculaceæ* usually represented there; unless indeed where the elevation of the ground above the sea-level makes up to a certain extent for the geographical position of the country. Thus the warmer parts of South America and India are almost wanting in plants of this order, the number of which increases as soon as we ascend the mountains in the north of India, or the chain of the Andes in the west of America. In Senegal there are only a few species of *Clematis*, and we must go to the Cape to find some Anemones and the known species of *Knowltonia*. In all very hot countries the sum of the species of *Ranunculaceæ* does not form one-hundredth part of the flora; while as we approach temperate countries the proportion gradually increases. In South Carolina (ELLIOTT), as on Chimborazo (JAMESON), the *Ranunculaceæ* represent two and a half per cent. of the whole number of species known. The proportion is the same too in Japan (ZUCCARINI).[1] There are from three to five per cent. in most temperate countries of the Northern hemisphere;[2] and the proportion increases to six per cent. in Patagonia towards the Antarctic Pole (J. HOOKER), and to from five to seven and a half per cent. in the Arctic Regions.[3] The countries richest in *Ranunculaceæ* extend round Lake Baikal, from Kamschatka to Daouria, since it is admitted that the family here forms from one-nineteenth to one-fifteenth of the whole flora; and in the Tschuki country it represents as much as one-sixteenth.[4] It must

[1] In China, according to DE BUNGE, the proportion is as high as 3·5 per cent.

[2] See the numbers given by A. DE CANDOLLE (*op. cit.* 1191-1260), with the names of the authors from which he has taken them; Russia in Europe, 5·5 (RUPRECHT); Faro Is., 4 (TREVELYAN); N. W. America, 6 (HOOKER & ARNOTT); United States, 2·5 (RIDDELL, BECK); S. Carolina, 2·5 (ELLIOTT); Chimborazo, 2·5 (JAMESON); Labrador, 4 (E. MEYER, HOOKER); I. of Sitcha, 3·5 (BONGARD); Daouria, 6 (LEDEBOUR); Altaï, 5 (LEDEBOUR); Kamschatka, 7 (HOOKER & ARNOTT); St. Petersburg, 3·5 (FISCHER-OOSTER); Silesia, 4 (WIMMER); Duchy of Posen, 4 (RITSCHL); Lithuania, 3 (GORSKI); Glarus, 5·5 (HEER); Morbihan, 2 (DELALANDE); Sierra-Nevada, 4·5 (BOISSIER); Balearic Is., 2·5 (CAMBESSÈDES); Greece, 2·5 (CHAUBARD). According to A. DE CANDOLLE (*op. cit.*, 1258), the proportion is the same—3·2 per cent. for the temperate regions of the Old World, and the centre of North America.

[3] At Hermit I., near C. Horn, 6 (J. HOOKER); and at Spitzbergen, 5 to 6 per cent.

[4] LECOQ, *op. cit.*, 405.

be borne in mind that the cold season should not become too long in each year as the altitude increases, for then the number of species would undergo some diminution. Thus of one hundred and thirty species[1] found in France, we have not more than half a hundred on the high table lands of the south-east.[2] The mineral character of the soil usually appears to make less difference to these plants than to many others. We see in our country *Clematis Vitalba* growing on limestone or sandstone soils; so will *Pulsatilla*, the Wood and other Anemones, the Columbine, *Ficaria*, many of the Crowfoots, and the Aconites. However *A. Anthora* prefers a calcareous soil, as do *Ranunculus Thora, hybridus, Villarsii*,[3] *arvensis*,[4] *Delphinium Ajacis, Thalictrum aquilegifolium, Adonis vernalis*, &c.; *Callianthemum* grows on primitive soils,[5] and *Myosurus minimus, Caltha palustris, Trollius europæus, Actæa spicata*, &c., seem to agree best with siliceous volcanic soils. Some genera and species have a very large area, especially (as always) the aquatic plants—*Batrachium*,[6] *Caltha, Ranunculus repens, arvensis*, &c. The genus *Ranunculus* is represented in almost every country of the globe. Almost all the genera belong to both Worlds, viz.—*Clematis, Thalictrum, Anemone, Ranunculus, Myosurus, Caltha, Isopyrum, Aquilegia, Delphinium, Actæa, Pæonia.* Only three small genera are limited to America: *Xanthorhiza, Hydrastis*, and *Crossosoma*. *Trollius, Nigella*, and *Callianthemum* grow in the Old World; while *Glaucidium* and *Anemonopsis* have only been found in Japan. As many as a thousand distinct species have been admitted;[7] but fortunately the tendency now is to keep down the number, which appears to have been far too much multiplied, many forms having been raised into distinct species by monographists.[8]

To man the *Ranunculaceæ* are sometimes useful, often dangerous. The foliage of many species has that dark green tint by which the peasant instinctively recognises a dangerous herb. Then they are often acrid, caustic, and poisonous. The Aconites, Hellebores, and Crowfoots have been in all times celebrated for these qualities.

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[1] The number of species admitted by GRENIER & GODRON, *op. cit.*, i. 3-53.

[2] LECOQ, *l. cit.*

[3] H. MOHL, ex A. DC., *op. cit.*, 436.

[4] LECOQ, *op. cit.*, iv. 483.

[5] H. MOHL, ex A. DC., *op. cit.*, 432.

[6] *Ranunculus aquatilis* is said to extend over at least a third of the earth's surface; so does *Caltha palustris*. In this order *R. aquatilis, Thalictrum alpinum, Myosurus aristatus* represent what are termed the *disjoined* species.

[7] DE CANDOLLE in 1824 only knew 541.

[8] Several of the species admitted by DE CANDOLLE have been split up. Many entirely new species have been since discovered, especially in America, China, and the Antarctic Zone. Nevertheless BENTHAM & HOOKER now-a-days only admit about 540 species.

The Ancients knew that Aconite was a very energetic poison, and potent remedy.[1] The name *Lycoctonum* (*Wolfsbane*) is enough to show that it was used to kill wild beasts. Formerly criminals were put to death by administering *Napellus*. In the East, and chiefly in India, the *Bikh*,[2] considered by WALLICH to be his *A. ferox*[3] is thought to be one of the most terrible poisons known. As drugs,[4] the Aconites—chiefly *Napellus*; more rarely *Anthora*, *paniculatum*, *Lycoctonum*, *ferox*—have been used in the treatment of neuralgia, deafness, rheumatism, gout, heart-disease, dyspnœa, dysentery, fever, purulent diathesis, chronic diseases of the skin, and also against erysipelas, glanders, farcy, syphilis, dropsy, metrorrhagia, intermittent fevers, &c. Their activity, whether as poisons or as remedies, appears to be entirely due to the presence of Aconitine, a principle discovered by BRANDES, and often administered in medicine instead of the plant itself.[5]

The Hellebores—especially *H. officinalis*,[6] *niger*, *fœtidus*, *hyemalis*, *orientalis*, and *viridis*,[7] were also known to the Ancients as poisons and as medicaments. In comparatively small doses, they act as energetic evacuants and parasiticides. Their use was formerly abused, especially in nervous affections; and we know that at least one species, conjectured to be *H. orientalis*,[8] was formerly supposed by physicians to cure madness. Now-a-days the Hellebores have nearly fallen into disuse, and are considered too dangerous to be administered.

The Crowfoots[9] are generally very acrid. The names *R. acris*, *sceleratus*, are enough to indicate their properties. *R. aconitifolius*, *bulbosus*, *gramineus*, *repens*, *tripartitus*, *Flammula*, *Lingua*, *Thora*, &c.,

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[1] "According to PLINY," says FUCHS (*Hist. des Plantes*, 68), it is quite certain that *Aconitum* is the suddenest of all poisons and venoms. Nevertheless hath it been turned to the usage of human health, as experiment teacheth that it is a sovereign remedy. . . . . *Aconitum* hath such a nature that it will kill a man if there be not in him something which it may kill; for then doth it wrestle and fight with the said poison, finding something of its own kind in the body. And this wrestling and fighting is only when the said *Aconitum* hath found other venom or poison in the inside. And it is a wondrous thing when two deadly poisons are in a man they kill and undo one another, and the man remaineth safe and sound." If we cite this passage, it is because it will equally apply to all the other dangerous *Ranunculaceæ* employed in medicine.

[2] Or *Bish*, *Vish*, *Visha*, *Ativisha*, &c. (See ROYLE, *Illustr.*, 40.)

[3] *Pl. As. Rar.*, i. 33, t. 41.—DC., *Prodr.*, i. 64.—*A. virosum* DON, *Prodr. Fl. Nep.*, 196.

[4] See PEREIRA, *Mat. Méd.*, ed. 4, ii. ii. 684. —*Dict. Enc. Sc. Méd.*, i. 577.

[5] See *Dict. Enc. Sc. Méd.*, i. 598.

[6] LINDLEY, *Bot. Reg.* (1842), t. 34, 58.

[7] GUIBOURT, *Drog. Simpl.*, 4th ed., iii. 690.—PEREIRA, *Mat. Med.*, 4th ed. ii. ii. 680, PAYER recognised what is sold in pharmacy as Black Hellebore, as being the rhizome of *H. viridis*.

[8] See BRAUN, *Pl. Hort. Berol.* (*Ann. Sc. Nat.*, sér. 4, i. 367.)

[9] PEREIRA, *l. cit.*, 678.—GUIB., *l. cit.*, 689.

are virulent, irritant, and epispastic, and are on this account employed in certain countries. Many are, it is said, energetic sudorifics like *R. glacialis.* In former times physicians used to consider that all the Crowfoots possessed "eminently caustic virtues."

In many other *Ranunculaceæ* the irritating principle is weaker, or else resides only in restricted parts of the plant. The Larkspurs are often only simple astringents, like *D. Consolida, Ajacis*; while the seeds of the Stavesacre[1] are sufficiently acrid to be used in powder as a drastic vermifuge, and especially as an insecticide. The seeds of the *Nigellæ* have only a pungent taste, like pepper, for which those of *N. sativa*[2] were formerly substituted (in France) under the name of "*Poivrette*" or "*Toute-Epice*" [i.e., *Allspice*]. The ancients employed various *Nigellæ* as emmenagogues, and as remedies for catarrhs.

The species of *Clematis* have also been long known to possess the power of ulcerating the skin when applied to it. *C. Flammula, recta,* and especially *C. Vitalba,* the common Traveller's Joy (Fr., *Herbe-aux-Gueux*—Beggars' Herb),[3] were said to be used by beggars to produce more or less intense vesications on the body. They are in fact epispastics, purgatives, and hydragogues. They were formerly considered remedies against itch, leprosy, scrofula, and even syphilis. The feathery elongated styles of certain species have been used to prepare a particular kind of paper.

Different species of the genus *Actæa,*[4] as we have limited it, have also been employed in medicine, especially in N. America. *A. brachypetala, racemosa,* and *Cimicifuga* are considered both astringent and irritant; they no doubt possess nearly the same properties as our *A. spicata* (*Baneberry*), which has been prescribed for its astringent, antispasmodic, evacuant, insecticidal and virulent qualities, probably

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1 PEREIRA, *l. cit.*, 682.—GUIB., *l. cit.*, 698.

2 GUIBOURT, *l. cit.*, 694.

3 The "*Viburnum, Black Vine* or *Black Bryony*" (*Viornes, Vignes noires, Couleuvrées noires*) of the older botanists (GUIB., *l. cit.*, 686). The "*Arabian Liana*" of the Isle of Bourbon (*C. maritima* LAMK.), according to M. VINSON (*Thès. Ec. Pharm.*, 1855), possesses energetic vesicating properties, and may be advantageously substituted for cantharides. *C. diœca L.*, according to MACFAYDEN (*Fl. Jam.* i. 2), is employed in Jamaica as an energetic hydragogue purgative; a decoction of the roots in sea water is used. *C. erecta, Vitalba, Viorna,* formerly much used in chronic diseases of the skin, only cured them by setting up a counter-inflammation of its own, which was often too violent and produced ulceration. *Thalictrum* has nearly the irritant properties of *Clematis,* but in a less degree. Accordingly the various species are sometimes used as purgatives in the country. *T. flavum* in particular, known in England as "*Meadow Rue,*" in several provinces goes by the name of "*Rhubarbe des pauvres*" (Ang., *Poor Man's Rhubarb*).

4 *Dict. Enc. Sc. Méd.*, i. 665.

resembling the Hellebores in every respect, with whose rhizomes those of the Baneberry have often been mixed.[1]

The various species of *Adonis*[2] have also been substituted for the Hellebores, according to CLUSIUS. They seem to have the same general properties as the Crowfoots. PALLAS relates that the root-stocks of the perennial species act as emmenagogues; and the *Cape Knowltonias* are irritating enough to give one of the species the name of *K. vesicatoria*, and it is in fact used in that country as a vesicant.[3]

The Anemones of this country are acrid,[4] containing a neutral, very virulent principle called *anemonine*, discovered by HEYER and BRUNSWICK. They irritate and vesicate the skin, are employed as antipsorics in veterinary medicine, and are said to kill certain animals if they feed on them. *Pulsatilla* is much used by the homœopathists, who allege that it is an excellent antidote to mercury, and that taken as snuff it is sovereign against cephalalgia and neuralgia, and also against colic, constipation, and diarrhœa, certain forms of hæmorrhage, rheumatism, convulsions, &c. Allopathists[5] know that it is irritant and vesicant, like most of the *Ranunculaceæ*. They ascribe to its revulsive action the remedial powers which country folks assert to be produced in certain fevers, if the leaves are applied continuously to the wrists. It sometimes induces healthy action in herpetic surfaces, but it may also ulcerate; it has been vaunted as efficacious against gout, itch, syphilis, amaurosis, hooping-cough, amenorrhœa, and calculus. ORFILA showed that it should be ranked among the most dangerous irritant poisons. It is used to prepare a distilled water sometimes employed as a cosmetic. There is no virtue that has not been attributed to *Hepatica*; its very name shows that it was thought to cure liver complaints; it was also thought efficacious against affections of the lungs, skin, and bladder, in hernias and wounds; now-a-days it has fallen into disuse.

Several of the *Ranunculaceæ* are bitter, and are hence esteemed as

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1 MURRAY, *App. Med.*, iii. 48.—BENTLEY, *Pharm. Journ.*, iii. 109. [*A. racemosa* and *Cimicifuga* have been used with great success in England in amenorrhœa, dysmenorrhœa, menorrhagia, and to replace ergot; it has also been found useful in various forms of rheumatic gout, rheumatism, lumbago, &c. See RINGER, *Handb. of Pract. Therap.* pp. 286-9. TRANS.]

2 *Dict. Enc. Sc. Med.*, ii. 40.

3 HARV. & SOND., *Fl. Cap.*, i. 4.

4 Physicians formerly confounded most of them with the Crowfoots, under the common name of *Coquerets*, attributing nearly the same properties to them.

5 STÖRCK, *Libellus de usu medico* Pulsatillæ *nigric.*, 1771.—GUIBOURT, *op. cit.*, 688.

tonics. The various species of *Coptis*,[1] and especially *C. Teeta* and *C. trifolia*, the "*Mishmee Bitter*" and "*Golden-thread*" of the Americans, are considered as such in the United States, and used against the aphthæ and stomatitis of children. The root-stock of the Canadian *Hydrastis*[2] is very odoriferous and extremely bitter; it is recommended as a powerful tonic, and it has been remarked that it contains *berberine*, a principle found also in *Xanthorhiza apiifolia*,[3] the "*Yellow-root*," which contains a very bitter resin, and is also a good tonic, and which might be substituted for *Quassia amara*; moreover, its wood is used to dye yellow.[4]

The Columbines are now-a-days by some authors considered to be only slightly tonic, and are nearly disused. The ancients were much divided as to their true remedial value.[5] So are the moderns; for if some consider the common Columbine diuretic, aperient, diaphoretic, antiscorbutic, pectoral, and allege that it keeps off gravel and stone, and cures icterus and the sweating in phthisis, and that its seeds favour the eruption in small-pox, scarlet-fever, and rot, others regard it as only slightly detergent and depurative, or else incline to fear it as being likely to produce the same effects as aconite. Its flowers are used, says MURRAY, to make a syrup resembling that made from violets. FOURCROY pointed out the presence of a very sweet perfume in its seeds. In this respect it resembles an Indian *Nigella*, which is, according to ROYLE, employed in spicing certain dishes in Afghanistan, which is known in that country under the name of *Siah-Dana*, and might very well be the *Black Cumin* of the Scriptures.

Few flowers of this order possess a sweeter scent than that of certain species of *Clematis*, which might be used in perfumery. Most *Ranunculaceæ* are inodorous; the Anemones, and among others the Wood Anemone, sometimes prized by the perfumer, have a slight

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[1] BIGELOW, *Med. Bot.*, i. t. 5.—PEREIRA, *Mat. Med.*, 4th ed., ii. ii. 698.

[2] BARTON, *Mat. Med.*, ii. t. 26.—BENTLEY, *Pharm. Journ.*, iv. (1862), 540.

[3] BARTON, *ibid.*—BENTLEY, *l. cit.*, 12.

[4] See p. 68. Many *Ranunculaceæ* contain colouring matters, but are little used as dyes. A large quantity of yellow pigment is found in the cellular tissue of the bark and medullary rays of several species of *Thalictrum*; *T. aquilegifolium*, *angustifolium*, *flavum*, &c., are used as dyes. The fruits of *Actæa spicata* furnish an ink and a red colour. *Adonis appenina*, *Caltha palustris*, *Coptis trifolia*, and *Hydrastis*, all dye yellow; the flowers of *Pæonia fæmina* red, of *Delphinium Consolida*, green; and the petals of the Columbine blue. The leaves of *Pulsatilla* are used to prepare a green ink, and its flowers are used to stain eggs in Wurtemberg (DUCHESNE, *Repert.*, 169-175).

[5] "It is not probable that a herb in no way acrid should have so great a virtue to resolve and to digest." (FUCHS, *op. cit.*, 78.)

scent. The yellow colouring matter of the perianth of certain Crowfoots, and of the Marsh-marigold, are said to be used to colour butter. Many of the *Ranunculaceæ*, especially those with double flowers,[1] serve to deck our gardens. *Ranunculus* and *Anemone* were among the six flowers which the botanists of last century deemed alone worthy of cultivation in the parterre. The species of *Clematis* are prized as climbers to cover arbours and walls.

Not less are the Pæonies appreciated in our gardens for the size and splendour of their petals, the sweet perfume they often give out, and the beauty of the fruits when half open. The male and female Pæonies (*P. corallina* and *officinalis*) were formerly highly valued medicines.[2] Stone, colic, icterus, the severest neuroses, epilepsy, convulsions, mania, the bite of venomous animals, abscesses—in short, nearly every known disease was thought to be cured by them. Now they are hardly used at all. The rootstock is somewhat astringent; the petals serve for making a distilled water and syrup of slightly sedative action; the seeds are emetic and cathartic. It is not known why necklaces made of them possess in certain districts the reputation of facilitating the dentition of children.

Since the time of KRAFFEN, it has been remarked that the irritant principle in the *Ranunculaceæ* has so little stability as to be usually dissipated by heat, boiling, or drying. The vegetable acids, and sometimes water alone, will destroy it; while its action is said to be increased by wine, alcohol, honey, and sugar. It does not exist in organs not fully developed, which explains how, in some countries, people have been able to use the young shoots of *Clematis*, *Ficaria*, and several *Ranunculi* properly so called, as aliments.[3] It would be prudent to exclude every plant of this order from our articles of food. It has often been remarked how strange it is that the *Ranunculaceæ*, so closely analogous to the *Papaveraceæ* in most features of their organization, are yet almost all unprovided with the abundant milky juice, possessing quite peculiar properties, found in a large number of the latter. However, the existence of laticiferous vessels has been pointed out in several of the *Ranunculaceæ*.[4]

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[1] In SEEMANN's *Journal of Botany* (1864), (177), will be found an enumeration of all the cultivated species of this order with double flowers.

[2] GUIBOURT, *op. cit.*, 701.

[3] *Ranunculus auricomus* and *lanuginosus* are boiled and eaten. The dry leaves of *R. aquatilis* are used as fodder in England and Alsace. It appears that the seeds of several Pæonies are also cooked and eaten. (DUCHESNE, *l. cit.*)

[4] SCHULTZ (C. H.), *Mem. Circ.* (1839), 35, 41, 92.

GENERA.

I. AQUILEGEÆ.

a. Flowers regular.

1. **Aquilegia** T.—Flowers 5-merous. Calyx petaloid imbricate deciduous. Petals 5, alternate with the sepals, usually calcarate. Stamens 8—10 alternating 5-merous verticils; anthers extrorse, dehiscing by 2 clefts. Staminodes within these 10, in 2 alternating verticils. Carpels 5, sessile free multiovulate. Follicles 5, polyspermous. Seeds albuminous, embryo minute.—Perennial herbs; leaves compound alternate; flowers solitary terminal, or in cymes (*Europe, Asia, N. America*). See p. 1.

2. **Xanthorhiza** Lhér.—Flowers 5-merous. Calyx petaloid imbricate deciduous. Petals 5, alternate with the sepals, unguiculate gland-like dilated at the apex. Stamens in 1—3 alternating 5-merous or in complete verticils. Anthers sublateral, dehiscing by 2 clefts. Carpels 5—15 sessile free pauciovulate. Follicles often 1-seeded by abortion.—A shrub, leaves alternate pinnatisect; flowers in few-flowered racemose cymes (*N. America*). See p. 6.

3. **Nigella** T. — Flowers 5-merous. Calyx petaloid imbricate deciduous. Petals (staminodes ?) opposite the sepals (often in pairs), bifid at the apex. Stamens spirally inserted; anthers introrse, dehiscing by 2 clefts. Carpels 2—15 (usually 5) connate at the base (obliquely inserted) many ovuled, dehiscing internally at the apex when ripe.—Annual herbs; leaves alternate dissected, often forming an involucre to the terminal flowers (*Europe, West Asia*). See p. 7.

4. **Helleborus** T.—Calyx 5-or 6-merous imbricate persistent or deciduous. Petals (staminodes ?) varying in number and position, gland-like, rarely 0. Stamens spirally arranged; anthers extrorse or introrse, dehiscing longitudinally. Carpels 2-∞, free or cohering at the base, sessile or stipitate, multiovulate, dehiscing as follicles when ripe. — Perennial herbs, with palmate or pedate leaves.

Flowers solitary, or few in cymes, naked or involucrate (*Europe, W. Asia, N. America*). See p. 12.

5. **Isopyrum** L.—Calyx 4—6-merous, petaloid imbricate deciduous. Petals (staminodes ?) of variable number gland-like, more rarely 0. Stamens spirally inserted, often few; anthers sublateral, dehiscing longitudinally. Carpels 2-∞, free, sessile, 1-∞ ovulate, dehiscing as follicles when ripe.—Annual or perennial herbs, with alternate or sub-opposite ternate leaves. Scapes 1- or many-flowered (*Europe, Asia, N. America*). See p. 18.

6. **Trollius** L.—Calyx petaloid 4-∞-merous deciduous, or more rarely persistent. Petals (staminodes ?) of variable number, or more rarely 0. Stamens numerous, spirally inserted; anthers extrorse or lateral, dehiscing longitudinally. Carpels 5-∞, free, sessile, dehiscing when ripe as many-seeded follicles. Seeds smooth or arillate.—Perennial herbs, with palmiveined leaves, entire, lobed, or compound; blade more rarely with inflexed auricles at the base. Scape one- or few-flowered (*Europe, Asia, N. & S. America, Australia*). See p. 20.

7? **Anemonopsis** Sieb. & Zucc.—"Calyx ∞-merous petaloid deciduous. Petals ∞, sessile shorter than calyx, with a nectariferous pit at the base. Stamens ∞, free. Carpels few free sessile multi-ovulate. Fruit ?—Herbs with ternately compound radical leaves. Flowers in lax racemes ?" (*Japan*). See p. 22.

8? **Glaucidium** Sieb. & Zucc. — Calyx 4-merous imbricate petaloid deciduous. Corolla 0. Stamens ∞, free, inserted in a spiral; anthers basifixed; cells lateral, dehiscing longitudinally. Carpels solitary or few (usually 2), obliquely inserted on the receptacles, like follicles when ripe but dehiscing dorsally. Seeds compressed, with winged margins.—A Perennial herb; leaves few alternate palmatifid; flower solitary pedunculate (*Japan*). See p. 23.

b. Flowers irregular.

9. **Delphinium** T. — Calyx 5-merous irregular imbricate; the posterior sepal more or less galeate or calcarate. Petals (staminodes ?)

unequal, in pairs opposite the sepals (posterior 2 calcarate, or cucullate and unguiculate; lateral and anterior, either wanting, or 6 of variable form, often reduced to minute scales). Stamens ∞, free inserted in a spiral; anthers introrse, dehiscing longitudinally. Carpels 1—5, sessile free multiovulate, when ripe dehiscing as follicles.—Annual or perennial herbs; leaves alternate, palmatifid or compound; flowers racemose 2-bracteolate (*Europe, Asia, N. America*). See p. 23.

II. RANUNCULEÆ.

10. **Ranunculus** Hall.—Calyx 5-, more rarely 3-merous, imbricate usually deciduous. Petals 3—20, with a nectariferous pit at the base furnished with a scale of variable form or 0, impressed imbricate forming a single or double corolla, more rarely wanting entirely. Stamens ∞ free, spirally inserted on a convex receptacle of variable form; anthers basifixed, lateral or extrorse, dehiscing longitudinally. Carpels ∞ uniovulate; ovule usually ascending; raphe introrse; micropyle extrorse inferior. Achenes as many as the carpels, capitate, coriaceous or membranous. Flowers often polygamous or diœcious.—Annual, or often perennial herbs; leaves alternate, entire or dissected, more rarely palmatifid. Flowers solitary terminal, or cymose pseudo-corymbose or umbellate (*cold and temperate regions of nearly the whole world, more rarely the Tropics*). See p. 32.

11. **Myosurus** Dill.—Calyx 5—8-merous: sepals with descending spurs. Petals (?) as many, small linear-tubulate nectariferous, or 0. Stamens and carpels of *Ranunculus* spirally inserted on an elongated branch-like receptacle; ovules solitary, pendulous in each ovary; micropyle introrse superior; raphe dorsal. Achenes ∞ spicate.—Annual herbs with entire leaves. Flowers pedunculate, solitary, terminal (*temperate regions nearly all over the world*). See page 40.

12. **Anemone** Hall.—Perianth 4— ∞-merous; leaves petaloid, or the outer ones more or less herbaceous, imbricated in one or more whorls. Stamens and carpels of *Ranunculus* spirally inserted on a conoidal or globose receptacle; outer stamens sterile and antherless, or more usually all fertile; anthers with lateral cells subintrorse or

subextrorse. Ovaries 5-ovulate; four superior ovules in two vertical pairs, abortive, minute; one inferior fertile usually descending; micropyle superior introrse. Fruit baccate or drupaceous, or more usually of capitate achenia, surmounted by the short, or caudate, naked or bearded styles. Seed ascending, or more usually descending, micropyle introrse.—Perennial herbs, with a subterranean stock, and alternate compound or lobed leaves. Flowers axillary, or more usually terminal, solitary, or in pseudo-umbellate cymes; involucre 1—3 leaved, at a variable distance from the flower; leaves entire or compound (*Europe, Asia, S. Africa, Australia, N. and S. America*). See p. 41.

13. **Callianthemum** C. A. Mey.—Perianth of *Ranunculus*, petals with a nectariferous pit at the base. Stamens ∞, free, spirally arranged; anthers dehiscing by lateral or subintrorse clefts. Carpels ∞, 2-ovulate; one ovule abortive, the other finally pendulous; micropyle superior extrorse, raphe introrse, achenes capitate naked.—Perennial herbs with alternate compound or incised leaves. Flowers terminal pedunculate (*Europe, temperate parts of Asia*). See p. 48.

14? **Hydrastis** L.—Calyx 3-merous petaloid very caducous. Stamens ∞, spirally arranged; anthers basifixed; cells dehiscing by lateral clefts. Carpels ∞ sessile 2-ovulate; one ovule usually ascending with the micropyle extrorse inferior. Fruit baccate capitulate; seeds crustaceous embedded in pulp.—Erect herbs with few alternate palmatifid leaves. Flowers solitary terminal (*N. America*). See p. 49.

III. CLEMATIDEÆ.

15. **Clematis** L.—Calyx 4-, more rarely 5—10-merous, petaloid valvate or induplicate, after expansion often imbricate. Staminodes external petaloid ∞, or more often 0. Fertile stamens ∞, free, spirally inserted on the convex receptacle, anthers dehiscing by lateral, more rarely introrse, clefts. Carpels ∞, free, ovaries 5-ovulate; ovules 4-superior in 2-vertical pairs, abortive minute; inferior fertile descending; micropyle superior introrse. Achenes capitate, surmounted by the short or caudate, naked or bearded style. Seeds descending. Flowers often polygamous or diœcious.—Most usually climbing

shrubs, or more rarely under-shrubs or herbs, with opposite leaves simple, or more often ternate or pinnate; petiole twining or produced into a tendril. Flowers in racemose cymes, more rarely solitary, naked or 2-bracteolate (*temperate regions nearly all over the world, more rarely in the Tropics*). See p. 50.

16. **Thalictrum** T.—Calyx 4-, more rarely 5—10-merous, petaloid, imbricate, deciduous. Stamens ∞, all fertile, or more rarely the outermost sterile and petaloid. Anthers dehiscing by sublateral clefts, ovaries uniovulate; ovule pendulous, micropyle introrse, superior. Achenes sessile or stipitate, triquetrous or membranous and inflated. Flowers often polygamous by abortion. —Perennial herbs, with alternate ternately compound leaves, often stipellate. Flowers in racemes, or more often racemose cymes (*N. Hemisphere of both Worlds, Tropical India, the Cape, S. America*). See p. 54.

17. **Actæa** L.—Calyx 3—6-merous, petaloid, imbricate, deciduous. Stamens ∞, all fertile, or more rarely the outermost sterile and petaloid, Anthers dehiscing by introrse or extrorse clefts. Carpels 1—∞, multiovulate, when ripe baccate, or more often dry and dehiscing as follicles. Seeds in two rows, smooth or scaly. Flowers more rarely polygamous by abortion.—Perennial herbs with alternate leaves, simple, or more usually ternately compound or decompound. Flowers in simple or compound racemes, usually terminal (*Europe, Asia, N. America*). See p. 56.

IV. PÆONIEÆ.

18. **Pæonia** T.—Calyx 5—6-merous, single or double herbaceous, imbricate, persistent, inserted round the plano-concave receptacle. Petals 5—10, forming a single or double corolla, efoveolate, imbricate, deciduous. Stamens ∞, free, perigynous; anthers dehiscing by introrse clefts. Disk within the androeceum, perigynous, either minute and gland-like, or less frequently much more developed sacciform and petaloid covering in the ovaries. Carpels 2—6, free, inserted in the bottom of the receptacle multiovulate, when ripe dehiscing as follicles. Seeds furnished with a minute funicular aril at the base.—Perennial herbs, more rarely shrubs or under-

shrubs, with alternate pinnately dissected or decompound leaves. Flowers terminal (*Europe, Asia, N. America*). See p. 59.

19. **Crossosoma** Nutt. — Calyx 5-merous, imbricate, inserted round the very concave receptacle. Petals 5, perigynous. Stamens ∞, perigynous, free; anthers attached by the back above the base, dehiscing by longitudinal lateral clefts. Carpels 2—5, inserted in the bottom of the receptacle, multiovulate, separating into two valves when ripe. Seeds reniform, provided at the base with a conspicuous multifid aril; embryo curved.—A small shrub, with alternate, simple, quite entire leaves. Flowers solitary terminal (*California*). See p. 62.

II. DILLENIACEÆ.

I. CANDOLLEA SERIES.

We shall commence the study of the *Dilleniaceæ* by analysing a *Candollea*.[1] *C. cuneiformis* Labill. (figs. 115–123), often cultivated in our conservatories, has regular hermaphrodite flowers. On the

Fig. 115.
Flowering Branch.

Fig. 116.
Flower.

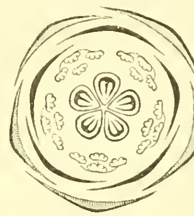
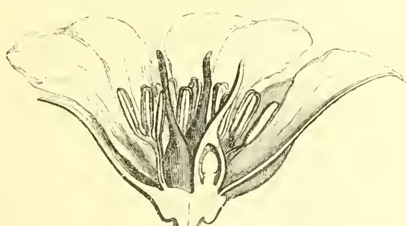
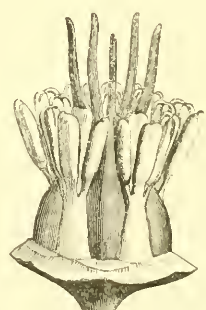


Fig. 117.
Diagram.





Candollea cuneiformis.

Fig. 118.
Longitudinal section of flower.

Fig. 119.
Flower without its perianth.

slightly convex receptacle are successively inserted from below

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[1] *Candollea* Labill., *Pl. Nov.-Holland.*, ii. 33, t. 176 (nec Baumg., nec Mirb., nec Radd.). —DC. *Prodr.*, i. 73.—Endl., *Gen.*, n. 4755. —Walp., *Rep.* i. 64; v. 11; *Ann.*, ii. 15.—Payer, *Organog. comp.*, 233, t. 51, f. 18-30. —B. H., *Gen.*, 14, n. 14.—Benth. & F. Muell., *Fl. Austral.*, i. 41.—H. Bn., *Adansonia*, vi. 279.

upwards the calyx and corolla (each with its leaves free), a hypogynous androceum, and a pluricarpellary pistil. The sepals are five in number, unlike,[1] and quincuncially imbricated in the bud. The petals, also five in number, alternate with the sepals and are imbricated in æstivation.[2] The stamens are grouped in as many bundles as there are sepals, to which they are superposed. Each bundle consists of a flattened tongue-like stalk, single below, and divided near its apex into three[3] short branches, each bearing a basifixed, two-celled, introrse anther, dehiscing longitudinally.[4] Internally is a fourth stamen, whose filament adheres to that common to the three outer stamens, and only becomes free on a level with its anther, which resembles the others. The gynæceum consists of five carpels opposite the petals, each composed of a unilocular ovary, tapering above into a style with a stigmatiferous tip.[5] The placenta occupies the inner angle of the ovary, and supports two ascending anatropous ovules, of which the raphe is in the first instance outward while the micropyle looks downwards and inwards.[6] The fruit, surrounded by the persistent calyx (fig. 121) consists of five follicles, which dehisce along the inner angle to free one or two seeds,

Fig. 121.
Fruit.

Candollea cuneiformis.

Fig. 120. Stamen. Fig. 122. Seed. Fig. 123. Seed. Longitudinal section.

[1] The more external they are, the more closely they resemble the upper leaves (with the spiral arrangement of which theirs is continuous) both in form and colour; but the more internal they are in the bud, the shorter, the broader, and the paler they become.

[2] The mode of this imbrication varies; it may become quincuncial, petals 1 and 3 then alternating with sepal 2.

[3] It often happens in this species that this tongue bears four anthers. Counting the inner stamen, we see that each bundle is pentandrous.

[4] The anthers have here the form of a flattened vertical bandlet, on the back of which the connective alone is seen. The cells, which are applied along the length of the inner surface, dehisce first above (fig. 120).

[5] This tip, scarcely dilated, becomes rapidly soft and, as it were, pulpy, bounded by the more consistent tissue of the subjacent portion of the style.

[6] Each has two very distinct coats, and the circumference of the umbilicus becomes thickened before flowering time into a small circular rim, the rudiment of the aril.

each with a membranous aril,[1] and containing within its coats the copious fleshy albumen, near the apex of which is a minute dicotyledonous embryo with its radicle inferior (figs. 122, 123).

C. cuneiformis, like several allied species, is a small Australian shrub bearing simple, alternate, subsessile, exstipulate leaves, with a gutter-like dilatation above the base. The flowers are solitary and terminate the branches (fig. 115). In some other species the flowers are solitary and imbedded in the centre of a bud, whose leaves pass gradually into the sepals. Sometimes, again, these plants are villous, with narrow leaves and slender branches, and assume the appearance of certain *Chenopods* or *Cistineæ*.[2] About fifteen species have been counted in Australia;[3] all have yellow flowers. There may be tolerably numerous variations in the number of stamens,[4] carpels,[5] and ovules.[6]

Adrastæa salicifolia.
FIG. 124.
Floriferous branch.

The genus *Adrastæa*,[7] of which but one species[8] is as yet known, a native of New Holland, presents nearly all the external characters of *Candollea* and *Hibbertia*, with which genus it has been proposed to unite it.[9] But on examining its androceum we see (figs. 124, 125) that it consists of two whorls of five stamens each; and what

[1] Here the aril is a large yellowish sac covering the seed entirely, its margins meeting, or even overlapping. In many species it is smaller; it does not cover the seed, and is divided near the opening into more or less lacerated lobes.

[2] This is especially the case with *C. helianthemoides* TURCZ. (*Bull. Soc. Natur. Mosc.*, xxii. ii. 8). The linear leaves, covered with whitish down, are collected around the flowers to form a sort of involucre. The staminal bundles only bear two or three anthers. The carpels are three in number, each usually containing but one ovule.

[3] STEUDEL, *Pl. Preiss.*, i. 273; ii. 236.—F. MUELL., *Fragm. Phyt. Austr.*, ii. 2; iv. 116; *Plants of Victoria*, i. 13.—BENTH., *op. cit.*, 41-46.

[4] In each bundle the number of anthers varies from two or three to an indefinite number. The alternipetalous bundles may even be replaced by single stamens. Besides this, single stamens are sometimes observed opposite the petals. (B. H., *loc. cit.*). The pollen grains have three longitudinal grooves.

[5] The two lateral carpels are often wanting. The surface of each is usually glabrous and traversed by a vertical groove along the internal angle.

[6] Many species, like *C. helianthemoides*, *C. pachyrhiza* BENTH. (*Hibbertia pachyrhiza* STEUD.), &c., have but one ascending ovule. More rarely three are observed, of which one is superior and nearly median.

[7] DC., *Syst.*, i. 424: *Prodr.*, i. 73.—ENDL., *Gen.*, n. 4752.—B. H., *Gen.*, 15, n. 15.—A. GRAY, in *Amer. Explor. Exped.*, i. 18.—BENTH. & F. MUELL., *Fl. Austr.*, i. 46.—H. BN., *Adansonia*, vi. 279.

[8] *A. salicifolia* DC., *loc. cit.*

[9] *Hibbertia salicifolia* F. MUELL., *Fragm.*, i. 161.

is most remarkable in the arrangement of these is, that those superposed to the five petals are external to those superposed to the sepals, enfolding and hiding them entirely in the bud.[1] Moreover, the sepals are unequal and quincuncial, the petals imbricated, the anthers introrse, dehiscing by two longitudinal[2] clefts, as in *Candollea*. The carpels, two in number, are free. The ovary contains one or two anatropous ascending ovules; the micropyle is originally[3] turned inwards, and even in the flower the umbilicus is surrounded by a rudiment of the arillary collar. The style, grooved the whole length of its internal angle, tapers upwards to a point. *A. salicifolia* is a small suffrutescent plant growing in marshy soils, wherein its woody stock burrows, covered with numerous adventitious roots. The slender branches bear alternate, very unequal leaves, placed close together on the axis of a short branch which ends in a nearly sessile flower. The sepals resemble the last leaves, the spiral of which they continue.

Adrastæa salicifolia.
FIG. 125.
Longitudinal section of flower.

Pachynema,[4] of the same country as *Adrastæa*, has its flowers (figs. 126, 127) similarly organized. But of the stamens only seven or eight are fertile. Their small anthers are two-celled and introrse; the filaments supporting them are dilated from above downwards to form a kind of pyramid. The two innermost stamens are reduced to these filaments, each bearing at the tip a sterile gland instead of

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[1] On this account we have not chosen *Adrastæa* as the first type of the *Dilleniaceæ*, and also because the exact alternation of these stamens with one another, and their exact superposition to the pieces of the calyx and corolla do not always exist. Hence we may conclude, as we have elsewhere said (*Adansonia*, vi. 265), "that here we have not to deal with the usual androceal whorls found in regularly diplostemonous flowers." The study of the evolution of the androceum will alone reveal its true symmetry. But there is no doubt that the stamens are not, as BENTHAM & HOOKER assert, *symplici serie æqualiter periphærica.*" Some are so much internal to the others, that in the bud they are not seen on removing the corolla.

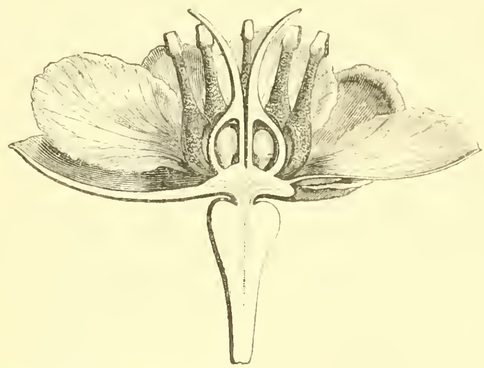
[2] These clefts begin near the top of the anthers; those of the two cells approach closely at the summit, but without coalescing. The filament, flattened and broad, is almost petaloid; the connective is continuous with it, and the anther cells are so applied on the inner face that nothing of them is seen on the dorsum.

[3] When there is but one, as it developes it undergoes a more or less decided twisting, so as to turn the micropyle sideways, or even outwards.

[4] R. BROWN, in DC., *Syst.*, i. 412; *Prodr.*, i. 70.—DELESS., *Icon. Sel.*, i. t. 73.—ENDL., *Gen.*, n. 4756.—B. H., *Gen.*, 15, n. 16.—BENTH. & F. MUELL., *Fl. Austral.*, i. 47.— H. BN., *Adansonia*, vi. 279.

an anther.[1] The carpels, two in number, are analogous to those of *Adrastæa.* Near the base of the inner angle are inserted two ascending ovules, of which the micropyle is at first introrse. The dry fruits often contain a single arillate seed.

Huttia,[2] which has been raised to the rank of a distinct genus, is merely a *Pachynema* with flattened staminal filaments not dilated



Pachynema complanatum.

FIG. 126. Floriferous branch.

FIG. 127. Longitudinal section of flower.

below; but one species is known, which has been rightly replaced in the genus *Pachynema.*[3] The small shrubs or undershrubs constituting this genus have no true leaves. They have only small scales or bracts arranged alternately on the axes, which may be nearly round or deformed—flattened like those of *Xylophylla,* and sometimes even very broad and quite leaf-like.[4] The flowers are axillary to these scales, solitary or in few-flowered cymes, and supported on short, often recurved, styles, with the dilated summit of which they are articulated.

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[1] The symmetry of the androeceum with respect to the perianth is not easy to make out in dried flowers. It seems that there is but one whorl of sterile stamens of which some are deduplicated. The fertile stamens are internal to these and alternate with the two carpels. (See *Adansonia,* vi. 266.) There are sometimes nine fertile stamens in *Pachynema,* and more usually seven, of which one appears to be exactly opposite a petal.

[2] DRUMM. & HARV., *Hook. Journ.,* vii. 51.—WALP., *Ann.,* iv. 37.—B. H., *Gen., loc. cit.*

[3] *P. conspicuum* BENTH., *Fl. Austr., loc. cit.,* n. 1.—*Huttia conspicua* J. DRUMM., *loc. cit.*

[4] There is hardly any natural order in which this sort of deformity of the axes which is usually correlated with the reduced appendicular system does not occur; we may cite in this place (besides the *Euphorbiaceæ*) the *Polygonaceæ, Umbelliferæ, Leguminosæ,* &c. *P. complanatum* R. BR., derives its specific name from the form of its branches, which are like little flattened bandlets, with nearly parallel edges, as in *Carmichælia, Bossiæa,* &c. The cladodia of *P. dilatatum* BENTH., have exactly the form of those of certain *Xylophyllas* from the Antilles.

II. HIBBERTIA SERIES.

In all the genera we have as yet examined, the number of stamens or bundles of stamens is definite. In *Hibbertia*,[1] on the contrary, we observe at maturity an indefinite number of stamens free, or nearly so, for almost their whole length. In other respects all the characters of the flower are those of *Candollea*. Thus, in the flower

Hibbertia volubilis.
FIG. 128.

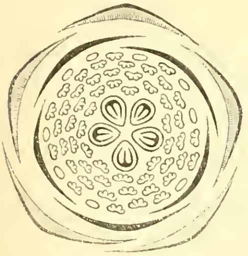
of *H. volubilis* ANDR.[2] (figs. 128, 130), we see, on the slightly convex receptacle, a calyx of five[3] unequal, unlike sepals quincuncially imbricated in the bud (fig. 129); a corolla of five petals alternate

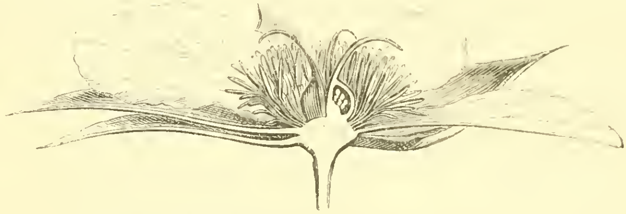
[1] *Hibbertia* ANDR., *Bot. Repos.*, t. 126, 472. —SALISB., *Par. Lond.*, t. 73.—DC., *Syst.*, i. 425; *Prodr.*, i. 73.—SPACH, *Suit. à Buff.*, vii. 420.—ENDL., *Gen.*, n. 4753.—PAYER, *Organog.*, 283, t. 51, figs. 1-17.—B. H., *Gen.*, 14, n. 13.—H. BN., *Adansonia*, vi. 279.

[2] *Bot. Rep.*, t. 126.—*Dillenia humilis* DON., *Cat. h. Cantabr.* (ex VENT., *Ch. de plant.*, 11).—*D. scandens* W., *Spec.*, ii. 1251.—*D. speciosa* CURT., *Bot. Mag.*, t. 449, nec THG.—*D. turneræflora* GAWL., *Bot. Rep.*, 27.

[3] In cultivation, we may find exceptional tetramerous flowers.

with the sepals, and of a somewhat variably imbricated æstivation; an androceum of a large number of stamens arranged, when at maturity,[1] without any apparent order below the gynæceum, and each formed of a filament free for almost its whole length, and a





Hibbertia volubilis.

FIG. 129.
Diagram.

FIG. 130.
Longitudinal section of flower.

basifixed, two-celled, introrse anther dehiscing by two longitudinal clefts.[2] These stamens are shorter, as they are more external; and some of them, quite outside the rest, are even reduced to short sterile rods. The gynæceum most usually consists of five[3] free carpels superposed to the petals, each consisting of a one-celled ovary, surmounted by a style, dilated and stigmatiferous at the tip. In the internal angle of the ovary is seen the placenta, which bears about half-a-dozen[4] anatropous, ascending ovules, of which the raphes tend to be adjacent. The thickened funicle is early dilated around the hilum to form the commencement of an aril.[5] The fruit is multiple, consisting of dry carpels, like those of *Candollea*, each containing one or more seeds, possessing a membranous aril more or less laciniate at the margin. *H. volubilis* is a sarmentose shrub, with alternate

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[1] We shall see that at an earlier period they are united into five bundles, of variable form, alternate with the petals. The anthers may be of the same form as in *Candollea* (fig. 120).

[2] The whitish pollen grains have each three equidistant longitudinal grooves.

[3] This species is one of those in which two whorls of carpels are pretty often found, of which the internal one consists of alternipetalous elements, and may be complete or incomplete. More rarely the carpels exceed ten in number. TURPIN has given a very exact figure of a plant with a gynæceum of eight carpels (*Dict. des Sci. Nat.*, t. 116); we rarely meet with less than five.

[4] This number varies; but most usually we find five or six ovules in two vertical rows; they are ascending, but at the same time turn towards one another, so that the raphes nearly touch. They have two coats, and the youngest are highest up on the placenta.

[5] It is a fair time before anthesis that the aril appears as a small ring, and afterwards as a cup with an entire rim. By the unequal development, this rim is more or less raised at various points—the origin of the deep lobing observed in the aril at a later period. The cells composing it are elongated and translucent, with thin, brittle walls.

exstipulate leaves articulated at the base. The flowers are solitary, and terminate the short branches[1] which bear below them a few alternate, more or less sepaloid, bracts.

Many other *Hibbertias*, which, like the one we have just studied, grow in Australia, present the same general organization, but with some differences in habit and flower. The stems do not climb, being suffrutescent,[2] or herbaceous.[3] The leaves may be narrow, like those of certain Heaths,[4] or dilated below into an imperfect sheath. The carpels contain a variable number of ovules,[5] and are themselves sometimes ten in number (five superposed to the sepals), or even indefinite. In some species the gynæceum consists of a single carpel.[6] But in all the stamens and the external staminodes, if present, are arranged in a circle round the carpels, an arrangement which calls to mind the name "*Cyclandra*,"[7] given to all this section of the genus *Hibbertia*.

Hibbertia tenuiramea.
Fig. 131.
Stamen.

The genus *Trimorphandra*[8] has been proposed for a cyclandrous *Hibbertia*, of which the outer stamens are short and sterile, as in most of the preceding plants; but some of the inner fertile stamens are longer than the others—a fact which exists in a

[1] *H. perfoliata*, Hüg., in *Pl. Preiss.*, i. 266 (*Candollea perfoliata* Lehm.), often cultivated in our conservatories, has a flower of the same construction as *H. volubilis*, with the outer stamens sterile, and with five carpels, each containing from two to four ascending ovules. The raphe is at first exterior, but as the ovules grow the raphes of the adjacent ovules turn towards each other. Besides the fact that the leaves should be noted for their sessile auriculate blades, we must especially notice that in this species the solitary terminal flowers are on long peduncles, but what has been termed *usurpation* takes place; the axillary branch being rapidly developed to form a pseudo stem, while the flower becomes very distinctly leaf-opposed. This occurs in several other species, though not so decidedly. When there are four ovules in two vertical rows the lower pair are much the older. Long before anthesis they have each an arillary ring round the umbilicus, while the others show no trace of it.

[2] This is the case in most of our cultivated species except *H. volubilis*.

[3] Like our cultivated *H. grossulariæfolia*, its habit has been compared to that of *Potentilla*.

[4] Especially in certain species of *Pleurandra* cultivated in our conservatories. Several have the aspect of certain *Salsolaceæ*, while others possess a whitish down recalling that of the Sunflowers.

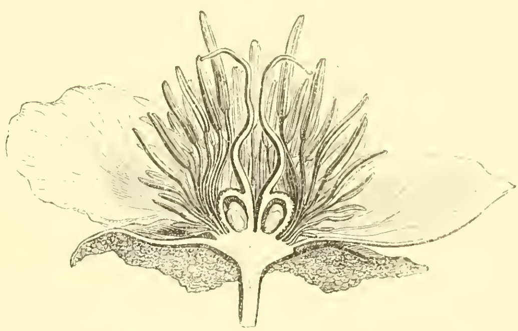
[5] As in *Trisema* from a couple to half a score may be counted, but rarely more than this. Their raphes are more or less turned towards one another.

[6] For instance, *H. monogyna* R. Br. (ex. DC., *Prodr.*, i. 74) which, with the androceum and perianth of the preceding species, possesses but one carpel with one or two ascending ovules in its ovary. This we at one time considered the type of a special section, very near *Trisema*, under the name "*Haplogyne*" (*Adansonia*, vi. 280). But this cannot be maintained as a distinct section if, following Bentham (*Fl. Austr.*, i. 37), we make *H. monogyna* only a variety of *H. diffusa* R. Br. (ex. DC. *Syst.* i. 429).

[7] F. Mueller, ex. B. H., *Gen.* 14, n. 13 (4).—*Ochrolasia* Turcz., *Bull. Mosc.*, xxii. (1849), ii. 3.

[8] *T. pulchella* Br. & Gr., in *Bull. Soc. Bot.* xi. 190; *Ann. Sc. Nat.*, sér. 5, ii. 148.

greater or less degree in many other species of *Hibbertia*, and hence does not appear of any great importance. In the species already known, a native of New Caledonia, whose flowers are in short, few-flowered axillary spikes, the large stamens near the centre are from two to four in number.[1] In another species, from Van Diemen's Land, which we have called *H. tasmanica*[2] (fig. 132), there are still more of these large stamens, of which upwards of six may often be noted. The flowers are also axillary, and pedunculate and solitary. Most of the organs, especially the branches, sepals, and ovaries, are covered with scale-like hairs.[3] The two carpels each contain a variable number[4] of ascending ovules in two vertical rows.



Hibbertia (*Trimorphandra*) *tasmanica*.
FIG. 132.
Longitudinal section of flower.

Hibbertia grossulariæfolia SALISB.[5] (figs. 133–134), a native of New Holland, sometimes cultivated in our conservatories, has been made by some authors the type of a distinct genus, *Burtonia*,[6] on account of several noteworthy characters. Before bearing the floral organs, the receptacle swells into a head, the upper surface of which is nearly flat. The perianth, consisting of five imbricate sepals, and five imbricate petals, is inserted with the androceum on the

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[1] We have observed (*Adansonia*, vi. 264) that if the large stamens when two in number alternate with the carpels, yet we can no longer find any such relations with the gynæceum when there are three or four of them; and further, on the strength of certain flowers "another genus *Tetramorphandra* might be founded; for in them we see several stamens intermediate between the long internal stamens and the outermost of the fertile stamens, both in position and in the length and form of the anthers."

[2] *Adansonia*, *loc. cit.* note 1. The internal stamens differ mainly in size, not form, from the middle ones.

[3] Several Oceanian species of *Hibbertia* also possess squamiform hairs on the calyx and gynæceum. From this peculiarity *H. lepidota* R. BR. (DC. *Syst. Veg.* i. 432) derives its name. In this the stamens are also remarkable, forming larger bundles with more stamens to each on the one side of the flower than on the other.

[4] In the New Caledonia species the number of ovules (six, according to the authors of the genus) may, as we have observed (*loc. cit.*, 263, note 2) be reduced to three. In the Tasmanian plant are three or four ascending ovules in each carpel.

[5] *Par. Lond.*, t. 73.—SIMS, in *Bot. Mag.*, t. 1218.—DC., *Prodr.*, i. 73.—*H. crenata* ANDR., *Bot. Rep.*, t. 472. — *H. latifolia* STEUD., from SPACH, *Suit. à Buff.*, vii. 419.

[6] SALISB., from DC., *Syst.*, i. 425.—*B. grossulariæfolia* SPACH, *loc. cit.* — *Warburtonia potentillina* F. MUELL., *Fragm.*, i. 230, t. 9; ii. 182.

circumference of this cup; the gynæceum is nearly central.[1] This last often consists of ten carpels,[2] five superposed to the sepals, and five alternate with them. The ovary contains two ascending ovules, whose micropyle is at first introrse: the style is bent outwards, and swells at the tip into a small stigmatiferous head, emarginate on the

Hibbertia (Burtonia) grossulariæfolia.

FIG. 133.
Flower.

FIG. 134.
Longitudinal section of flower.

inside. The stamens, whose anthers are distinctly introrse,[3] are shorter, as they are the more external; usually some of these are even sterile, as in *H. volubilis.* The peculiar form of the receptacle produces a somewhat perigynous insertion of the outer whorls, and so gives the flower quite the appearance of several *Rosaceæ,* such as *Potentilla* or *Geum.* The branches of *H. grossulariæfolia* are slender and sarmentose. The petioles of the alternate leaves are dilated at the base. The flowers, really terminal, in time become lateral and leaf-opposed.[4]

In these species, and in all those analogous to them,[5] the stamens occupy the centre of the flower, as we have said above. In those

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[1] The younger the flower is, the larger is that dome-shaped summit of the receptacle around which the carpels are inserted to form a sort of crown, but leaving the very centre quite free.

[2] There may be more or less than ten. In the latter case the position of the two or three supernumerary carpels is not constant.

[3] Later the micropyle is more or less bent outwards. Long before the flower expands the hilum is surrounded by a small arillary ring.

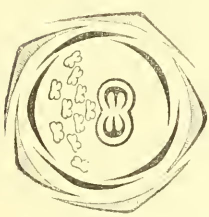
[4] Besides the leaf opposite the inflorescence separated from it by a "usurping" bud rapidly developed into a pseudo-stem, the floral peduncle may be accompanied by another leaf opposite the first, often but little developed and reduced to a bract. This arises not from the branch but from the peduncle, which may bear it either close to its base as described, or at a variable height, and which sometimes bears several other alternate bracts.

[5] These alone form the genus *Hibbertia* of DE CANDOLLE & ENDLICHER, maintained as a distinct genus by BRONGNIART, who thinks that "these modifications in the organization of the androceum supply good generic distinctions" (*loc. cit.*).

united under the name of "*Pleurandra*,"[1] which have been considered by some authors as a distinct genus, but which, despite their opinion, cannot easily be distinguished from *Hibbertia*,[2] the androceum is restricted to one side of the receptacle, and the gynæceum, which at first occupied its top, is hence thrown to one side. The perianth is as in the cyclandrous *Hibbertiæ*. Thus, in the flower of *P. Readii* Hort. (figs. 135–138), cultivated in our conservatories,

Fig. 135.
Flower.

Fig. 136.
Longitudinal section of flower.



Hibbertia (*Pleurandra*) *Readii*.

Fig. 137.
Diagram.

Fig. 138.
Flower without its perianth.

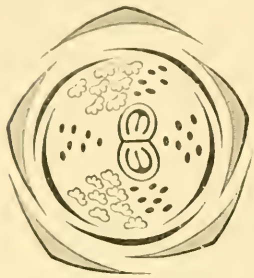
we find a calyx of five quincuncially imbricated sepals, a corolla of five petals alternate with these, imbricated, or more rarely contorted in the bud. The stamens are united near their bases into an oppositipetalous bundle.[3] The basifixed introrse two-celled anthers dehisce longitudinally. The gynæceum consists of two excentric

[1] Labill., *Nov.-Holland.*, ii. 5, t. 143, 144. —DC., *Prodrom.*, i. 71.—Delessert, *Icon.*, i. t. 78-81.—Endl., *Gen.*, n. 4754.—Payer, *Organog.*, 234.—H. Bn., *Adansonia*, iii. 129; vi. 262.—*Cistomorpha* Cal. (from Lindl., *loc. cit.*).

[2] Accordingly Bentham & Hooker have reunited these genera (*Gen.*, 14).

[3] We have observed (*Op. cit.*, 130) that the formation of this bundle begins by a single nipple-shaped swelling, nearly central, but somewhat nearer petal No. 5, than the others. This single sepal is later on deduplicated centrifugally.

carpels, each superposed to a petal,[1] which appear to cohere for a certain distance along the inner angle, where each ovary contains a vertical placenta bearing two parallel rows of ascending anatropous ovules; the micropyle looks downwards and inwards. The plant is frutescent, and gives off linear exstipulate leaves. The flowers are terminal, and usually solitary.



Hibbertia angustifolia.
FIG. 139.
Diagram.

In certain species of *Pleurandra*, the stamens nearest the perianth are reduced to staminodes;[2] and in others, which offer a good transition between these and the cyclandrous *Hibbertiæ*, there are not only staminodes intermixed with the fertile stamens,[3] but on the other side of the gynæceum, whose organization remains unaltered are some of these sterile filaments which never become fertile.[4] Now so numerous are the transitions between the species of *Hibbertia* which possess a circular and perfect androceum, and those which possess unilateral stamens, either all fertile or all sterile, that after studying all the species it appears impossible to split them up into sufficiently distinct generic groups.[5]

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[1] We have observed (*loc. cit.*) how the gynæceum first appears as two carpellary leaves superposed to the petals which alternate with sepal 5, and how the apparently alternipetalous dissepiment is formed merely by the floral axis drawn out into a wedge and receiving the insertion of the bases of the carpellary leaves on its very oblique faces.

[2] This occurs not only in *Pleurandra* properly so called, but also in *Hemistemma* (ex. DC., *Syst.*, i. 412; *Prodr.* i. 71; DELESS., *Icon.*, t. 74–77; — ENDL., *Gen.*, n. 4757;— WALP., *Ann.*, i. 16, some of which are Oceanian, while others come from Madagascar — the latter often possessing opposite or nearly opposite leaves. They were collected and studied for the first time by COMMERSON and by NORONHA, who, according to DUPETIT-THOUARS (*Gen. Madagasc.*, 18), gave them the name *Aglaja*. In *H. Commersonii* DC., there are flowers without sterile stamens. Each carpel contains two ovules. The gynæceum is the same in *H. dealbata* R. BR., where the insertion of the styles is much bent outwards. The fertile stamens have long erect linear introrse anthers, the external staminodes are much shorter. On *Hemistemma*, see also HOOK. F., *Hook. Journ.* x. 48; and F. MUELLER, *Fragm.* i. 151. This last observer has also clearly shown that species like *H. spicata* serve as a passage between *Pleurandra* and *Hemistemma* (*Fragm.* ii. 1).

[3] *Hemipleurandra* BENTH. & HOOK. (*loc. cit.*). "*Stamina unilateralia; staminodia ad utrumque latus staminum sita v. in tota peripheria. In* Hemistepho DRUMM. & HARV. (*Hook. Journ.*, vii. 51) *pedunculi unilateraliter ∞-flori et staminodia nonnulla etiam sub staminibus observantur.*" *Hemistephus linearis* DRUMM. & HARV. was to F. MUELLER *Hemistemma lineare* (*Fragm.*, i. 162). The same author has proposed a section *Dipleurandra* for his *H. asperifolia*.

[4] In *H. angustifolia* BENTH. (*Fl. Austr.*, i. 21), the diagram of which is given in fig. 139, we often see two bundles of fertile stamens, with a bundle of staminodes between them—one on each side, and a fourth the other side of the gynæceum.

[5] "*Genus e staminum indole commode in sectiones 4 dividitur, quarum nonnullæ ab auctoribus pro generibus habentur. Nimis tamen artificiales sunt, nec habitu consonant.*" (B. H., *loc. cit.*)

For the same reasons, *Trisema* Hook. F.,[1] which Father Montrouzier[2] names *Vanieria*, should also be included in the genus *Hibbertia*. The single carpel,[3] whose ovary contains as many as a dozen anatropous ascending ovules, is surrounded by a large number of unequal fertile stamens, with narrow two-celled anthers dehiscing laterally, and by a calyx of five imbricate sepals, alternating with which we often see but three or four petals. The flowers grow in terminal unilateral spikes, like those other Oceanian species of *Hibbertia*, called *Hemipleurandra*, or those *Hemistemmas* which grow in Australia and Madagascar.

Fig. 140.
Schumacheria castaneæfolia.

These last have opposite, or nearly opposite leaves, unlike all the other species of the genus *Hibbertia*, as we limit it,[4] which are shrubs, or undershrubs, with exstipulate leaves, whose petioles are articulated at the base. About eighty species are known,[5] without counting those described as such, but which should only be retained as varieties.

The genus *Schumacheria*[6] consists of plants whose sessile or sub-sessile flowers are grouped in unilateral inflorescences (fig. 140), like those of the sections *Hemistemma*, *Trisema*, &c., of *Hibbertia*, from which, on the

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[1] *Hook. Journ.*, ix. 47, t. 51.—Br. & Gr., *Ann. Sc. Nat.*, sér. 5, ii. 150; *Bull. Soc. Bot. de Fr.*, xi. 191.—H. Bn., *Adansonia*, vi. 259.

[2] *Mém. Acad. Lyon*, x. (1860), 176.

[3] Owing to this single carpel, *Trisema* is to the other *Hibbertias* with unilateral inflorescences, what *H. monogyna* R. Br. is to the other pleiogynous species of Australia whose inflorescence resembles its own. But it appears to us impossible to retain this as a distinct genus (see *Adansonia*, vi. 269).

[4] *Hibbertia.* Sections 7.
1. *Cyclandra.*
2. *Burtonia.*
3. *Trimorphandra.*
4. *Trisema.*
5. *Hemistemma.*
6. *Hemipleurandra.*
7. *Pleurandra.*

[5] DC., *Prodr.*, i. 71, 73.—Walp., *Rep.*, i. 64; ii. 746; v. 8; *Ann.*, i. 15; ii. 14; iv. 35.—Bentham, *Fl. Austral.*, i. 17.—F. Muell., *Fragm.*, i. 161, 217; ii. 1; iii. 1; iv. 115, 151.—Hook. F., *Fl. Tasman.*, 13.—A. Gray, *Amer. Explor. Exped.*, i. 20.

[6] Vahl., *Kiöbenh. Selskab. Skrift.*, vi. 122.—

whole, it differs only in a very limited number of characters. The calyx consists of five imbricated sepals (fig. 141), the corolla of as many petals, also imbricated. The numerous stamens are all situated as in *Pleurandra*, on one side of the receptacle, opposite one of the sepals; the filaments, free above, are united below into a blade concave internally.[1] The anthers are erect,[2] consisting of two cells adnate for their whole length to the borders of the connective, and dehiscing by two short clefts, or elongated pores, one on each side of the top of the connective. The gynæceum is excentric, consisting of two free carpels placed face to face, one side of each being turned towards the concavity of the androceum. There is often also a third carpel placed between the two others and the androceum to which it turns its back. Each of these carpels consists of a uniovulate ovary, tapering into a slender style, whose tip is covered internally by stigmatic papillæ. The ovule, inserted near the base of the ovary, is ascending, with the micropyle downwards and inwards. The fruit consists of two or three dry indehiscent one-seeded carpels; and the arillate seed[3] contains a minute embryo near the apex of the fleshy albumen. The genus *Schumacheria*

Schumacheria castaneæfolia.
FIG. 141.
Flower.

Tetracera Boiviniana.[4]
FIG. 142.
Fructiferous branch.

ARNOTT, *Edinb. New Philos. Journ.*, xvi. 315. —WIGHT, *Illustr.*, t. 4.—ENDL., *Gen.*, n. 4751. —HOOK. & THOMS., *Fl. Ind.*, i. 65.—WALP., *Rep.*, i. 64; *Ann.*, iv. 35.—B. H., *Gen.*, 13, n. 8—H. BN., *Adansonia*, vi. 280.—*Pleurodesmia Grahamii* ARN., *loc. cit.*

[1] The base of the androceum forms a sort of imperfect tube, or shell, recalling that of *Lecythis*.

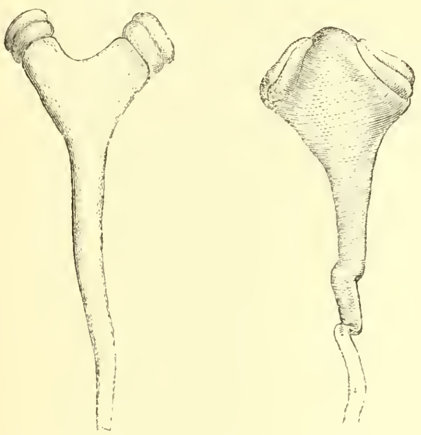
[2] That is, when adult; but at a certain stage the filaments are bent down on the gynæceum.

[3] Its surface is punctate; the aril is but little developed.

[4] See *Adansonia*, vii. 300, t. vii. This species, a native of Montbaze and Zanzibar, is, so to speak, intermediate between *Tetracera* and *Hibbertia*.

of which but few species are known, natives of Ceylon,[1] consists of climbing shrubs, whose curved branches bear alternate leaves, the petioles of which are channelled and dilated at the base to ensheath the branch to a variable extent. The secondary nerves of the blade are parallel and very near one another.[2] The spikes of flowers are grouped into terminal or axillary ramified bunches, each flower is accompanied by two unequal lateral bracts.[3]

The genus *Tetracera*[4] has the perianth of *Hibbertia* or *Schumacheria*—*i.e*, usually five imbricated sepals,[5] and as many imbricated petals.[6] The indefinite stamens, arranged all round the receptacle as in *Cyclandra*, have a peculiarity, which, of no great importance in itself,[7] is yet useful in practical determinations. The filament, corrugated in the bud, is gradually dilated towards the tip, and bears an anther whose cells



Tetracera obovata.
FIGS. 143, 144.
Stamens.

Tetracera (Delima) sarmentosa.
FIG. 145.
Flower.

are small and more or less separated, and parallel or diverging below.

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[1] THWAITES, *Enum. Pl. Zeyl.*, 4.

[2] All these parts are rich in a blackish colouring matter.

[3] These flowers are (as we have stated) unilateral, like those of many species of certain sections of *Hibbertia;* it is very difficult to find characters of any value by which to distinguish clearly *Schumacheria* from these.

[4] L., *Gen.*, n. 683.—JUSS., *Gen.*, 339.—DC., *Prodr.*, i. 67.—SPACH, *Suit. à Buff.*, vii. 414.—ENDL., *Gen.*, n. 4765, 4766.—B. H. *Gen.*, 12, n. 6.—H. BN., *Adansonia*, vi. 259–280 (incl. *Delima* L., *Trachytella* LOUR., *Assa* HOUTT., *Doliocarpus* ROL., *Ricaurtea* TRIAN., *Soramia* AUBL., *Tigarea* AUBL., *Rhinium* SCHREB., *Calinea* AUBL., *Euryandra* FORST., *Whalbomia* THG., *Rhœlingia* DENNST., *Delimopsis* MIQ.).

[5] The imbrication varies, but is often quincuncial. We often observe six, or more frequently four, sepals, of which the outermost is broader and thicker than the rest.

[6] One or two petals may be wanting, as is very frequently the case in *Delima*.

[7] We shall see that too absolute a value has been assigned it, and that in the groups *Hibbertieæ* and *Dilleniææ* are plants whose anthers have similar dilated connectives.

They are either lateral, subextrorse, or subintrorse,[1] and dehisce by longitudinal clefts (figs. 143, 144). The gynæceum consists of free carpels superposed to the petals, and of equal number, fewer, or solitary (fig. 145). In some species the flowers may even be polygamous, owing to the complete abortion of the gynæceum.[2] Of the same form as in *Hibbertia*, these carpels each contain at least two, often more, ascending ovules in their ovaries.[3] The fruit is dry, and dehisces either by one internal cleft or by two longitudinal clefts. It contains one or several seeds, each of which has an aril of variable size,[4] and contains a small embryo at the apex of the abundant fleshy albumen.

The name *Delima*[5] has been given to a *Tetracera*[6] with unicarpellary flowers (fig. 145), the ovary of which contains a fairly large number of ascending ovules ;[7] that of *Ricaurtea*[8] to some American *Tetraceras*, in which the single carpel becomes a fruit with a somewhat fleshy pericarp dehiscing in two lateral valves ; that of *Doliocarpus*[9] to other species in which the more or less succulent pericarp does not dehisce when ripe. But in other respects all these plants present all the characters of *Tetracera* in organization and habit, so that it seems to us they cannot be separated generally.

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[1] These variations may, as we shall see, occur in different stamens of the same flower, the direction of the cells seeming to be partly owing to the deformity undergone by the connective from the pressure of the surrounding stamens.

[2] There are whole branches in *T. volubilis* and some other species which bear only staminate flowers.

[3] *T. Assa* has as many as a dozen ; *T. Sarmentosa* has up to ten.

[4] The aril is usually seen in unexpanded flowers as a little collar round the base of each ovule.

[5] L., *Gen.*, n. 683 ; *Amœn.*, i. 403.—Juss., *Gen.*, 339.—DC., *Prodr.*, i. 69.—Endl., *Gen.*, n. 4764–4766.—B. H., *Gen.*, 12, n. 5.—Walp., *Rep.*, i. 67 ; *Ann.*, ii. 17; iv. 36.—*Trachytella* DC., *Syst.*, i. 410.—*Leontoglossum* Hance, *Diagn. Chin.*, ex Walp., *Ann.*, ii. 18 ; iii. 812.—*Korosvel* Herm., ex Adans., *Fam.*, ii. 442.

[6] *T. sarmentosa* Vahl., *Symb.*, iii. 70 ; Roxb., *Fl. Ind.*, ii. 645.—*Actæa aspera* Lour., *Fl. Cochinch.*, i. 408.—*Delima sarmentosa* L., *Spec.*, 736 ; DC., *Prodr.*, i. 69.—*D. hebecarpa*, DC., *Syst.*, i. 407.—*Trachytella Actæa* DC., *Prodr.*, i. 70.—*Leontoglossum scabrum* Hance.—*L. sarmentosum* Hance.

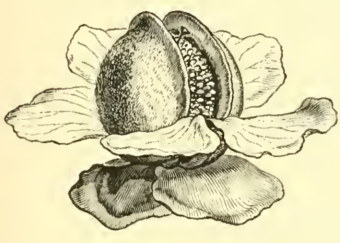
[7] From four to five, horizontal, or somewhat ascending, in each vertical row. The single carpel tapers up into a style, whose tip is crowned by a small stigmatiferous enlargement. The placenta is superposed to one of the sepals. These are very unequal, the outer ones being much smaller in proportion than the two innermost. This difference is the first stage towards the arrangement in *Davilla*. The corolla often consists of only three petals, of which one is anterior. The anther-cells are usually extrorse, and open by somewhat oblique clefts. The fruit is dry, and opens like a pod from above downwards, both internally and externally. Most of the ovules abort, so that only one or two ascending seeds remain, each surrounded by a yellow aril, split up into narrow teeth longer than the seed. The outer integument is polished blackish thick and testaceous ; the inner one is thin membranous and whitish. The albumen is fleshy, and the embryo very minute. The habit of this plant is very fairly represented in the *Botanical Magazine*, t. 3058.

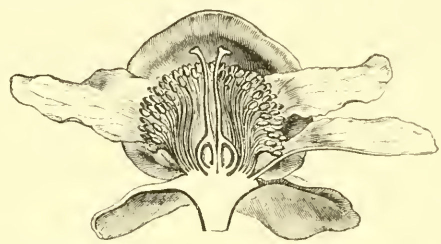
[8] Triana, *Ann. Sc. Nat.*, sér. 4, ix. 46.

[9] Roland., *ex* DC., *Syst.*, i. 405 ; *Prodr.*, i. 69.—Walp., *Rep.*, i. 65 ; ii. 746; v. 13 ; *Ann.*, i. 15; ii. 17.—Pl. & Triana, *Ann. Sc. Nat.*, sér. 4, xvii. 19.—B. H., *Gen.*, 12, n. 4.—H. Bn., *Adansonia*, vi. 259–280.

Thus defined,[1] the genus *Tetracera* consists of half a hundred species of small trees or shrubs (often climbers) found in warm countries all over the world; in equinoctial America,[2] Senegal,[3] Madagascar, tropical Asia,[4] North Australia,[5] and New Caledonia.[6] Some species of *Delima* come from tropical Asia, and the Indian Archipelago.[7] *Ricaurtea* is from Columbia; *Doliocarpus* from Guiana, Brazil, and some other parts of South America.

The American genus *Davilla*[8] (figs. 146–148) may be considered as *Tetracera*,[9] in which, on the commencement of anthesis, the two





Davilla wormiæfolia.

Fig. 146. Flower.

Fig. 147. Longitudinal section of flower.

interior sepals became greatly developed, approaching one another to form two hollow hemispheres which persist around the fruit. The petals, stamens, and carpels, constructed like those of *Tetracera*, present the same modifications in form as in that genus.[10]

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1 *Tetracera.* Sections 4.
1. *Euryandra* (*Wahlbomia*). Several carpels.
2. *Delima* (*Delimopsis?*). Carpel single; dehiscence univalvular.
3. *Ricaurtea*. Carpel single; dehiscence bivalvular.
4. *Doliocarpus* (*Othlis*, *Soramia*, *Calinea*, *Tigarea?*). Carpel single, fleshy, indehiscent.

2 Aubl., *Guian.*, ii. 920, t. 350, 351.—A. S. H., *Flor. Bras. Merid.*, i. 11.—Presl., *Rel. Hænk.*, ii. 71.—Pl. & Trian., *Ann. c. Nat.*, sér. 4, xvii. 20.—Eichl., in Mart., *Fl. Bras.*, *Dilleniac.*, 83, t. 21–23.

3 Guillem. & Perr., *Tentam. Fl. Senegamb.*, i. 2, t. i.

4 Hooker & Thoms., *Fl. Ind.*, i. 62.—Miquel, *Fl. Ind. Bat.*, i. pars alt., 8.—Thwait., *Enum. Pl. Zeyl.*, 1.

5 F. Muell., *Fragm.*, v. 1, 191.

6 Labill., *Sert. Caled.*, 55, t. 55.—Montrouz., *Fl. Ins. Art* (*Mem. Acad. Lyon*, x. 175).—Br. & Gr., *Bull. Soc. Bot. Fr.*, xi. 190; *Ann. Sc. Nat.*, sér. 5, ii. 150.

7 Benth., *Fl. Hongk.*, 7.—Miquel, *Fl. Ind. Bat.*, i. pars alt., 7. *Delimopsis*, a Javanese plant, described in the same work (9) all the organs of which are covered with hairs and whose flowers have but one carpel should not, it seems to us, be separated from the *Tetraceras*, of the section *Delima*.

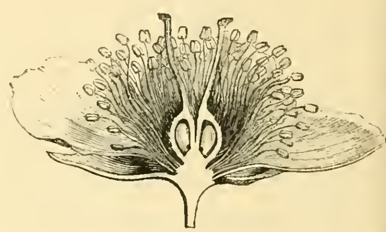
8 Vandell., ex DC., *Syst.*, i. 404; *Prodr.*, i. 69.—Spach, *Suit. à Buff.*, vii. 415.—Endl., *Gen.*, n. 4763.—Walp., *Rep.*, i. 66; ii. 746; v. 13; *Ann.*, i. 15; ii. 17; iv. 36.—B. H., *Gen.*, 12, n. 2.—H. Bn., *Adansonia*, vi. 269, 271, 272.—*Hieronia* Velloz., *Fl. Flum.*, v. t. 116.

9 A. S. H., *Pl. Us. Brasil.*, t. xxii. xxiii.; *Ann. Sc. Nat.*, sér. 2, xvii. 130.—Eichl., *Op. cit.*, 94, t. 24-27.—Presl., *Rel. Hank.*, ii. 72. Seem., *Bot. Her.* t. 13.—Pl. & Triana, *Ann. Sc. Nat.*, sér. 4, xvii. 18.—H. Bn., *Adansonia*, vi. 272.

10 There is sometimes a single carpel, as in *D. multiflora* A. S. H., sometimes two, as in *D. elliptica* A. S. H., and sometimes even more. In the flowers of certain species, such as *D. rugosa* Poir., the gynæceum is pretty

Curatella[1] (figs. 149, 150) is also very near *Tetracera;* the hermaphrodite flowers are more usually tetra- than pentamerous, and consist of imbricate sepals; petals also imbricated, and longer than the sepals; numerous hypogynous stamens whose filaments are bent in the bud, and dilate towards the tip into a connective which bears the two adnate anther cells, whose dehiscence is nearly lateral;[2] and two carpels which appear united along the lower part of their inner angles—an appearance due to the very oblique insertion of their bases on the faces of the dihedral angle formed by the central projection of the receptacle. Each ovary contains two collateral ascending ovules, whose micropyles originally[3] look downwards and inwards. The styles are distinct, and, traversed by an internal longitudinal groove, they are somewhat dilated in the stigmatiferous portion. The fruit consists of two dry dehiscent[4] or indehiscent[5] carpels, each containing one or two arillate seeds. This genus

Davilla Kunthii.
FIG. 148.
Fruit in its indusium.



Curatella americana.

FIG. 149.
Flower.

FIG. 150.
Longitudinal section of flower.

consists of climbing shrubs from Guiana,[6] Brazil,[7] and the neigh-

frequently wanting or reduced to an insignificant rudiment, so that the plant becomes polygamous. There are usually two collateral ascending ovules in each ovary, with their micropyles downwards and inwards. The umbilicus early bears a rudimentary aril, which is afterwards well developed.

[1] L. *Gen.*, n. 679.—LŒFL., ex ADANS., *Fam.*, ii. 450.—JUSS., *Gen.*, 282.—DC., *Prodr.*, i. 70. —SPACH, *Suit. à Buff.*, vii. 417.—A. S. H., *Pl. Us. Brasil.*, t. xxiv.—ENDL., *Gen.*, n. 4759. —WALP., *Rep.*, i. 65.—PL. & TRIAN., *Ann. Sc. Nat.*, sér. 4, xvii. 15, 23.—B. H., *Gen.*, 12, n. 3.—H. BN., *Adansonia*, vi. 280.—*Pinzona*, MART. & ZUCC., *Flora* (1832), ii. Beibl., 77.

[2] The clefts are somewhat nearer the inner than the outer face; the connective is flattened, rectangular; and the filament is dilated below the anther.

[3] Later the ovule undergoes a slight twisting on its vertical axis, turning the micropyle sideways and outwards, while the raphe approaches that of its neighbour. At the base of the ovule appears a small collar-shaped thickening, the first trace of the aril.

[4] The true *Curatellas*, of which *C. americana* L. is the type, are marked by the very distinct dorsal dehiscence of the carpels.

[5] The incompleteness of the dehiscence or its entire absence characterizes *Pinzona*, which cannot be separated generically from *Curatella* for this reason alone.

[6] AUBLET, *Guian.*, i. 579, t. 232.

[7] A. S. H., *Pl. Us. Brasil.*, *loc. cit.*—NETTO, *Itin. Bot.*, 16.—EICHL., *op. cit.*, 67, t. 15.

bouring regions of tropical America.[1] The flowers are grouped in short many-flowered clusters of cymes, arising either from young shoots or from the wood of the old branches.

As for the leaves, they are the same in all the genera we have just studied, presenting the same appearance in *Tetracera*, *Davilla*, and *Curatella*. They are simple and alternate; the petiole is sometimes dilated, and channelled, or with a double stipuliform marginal wing; the blade is simple, entire or slightly crenate or dentate, with numerous parallel secondary ribs at short distances from one another, extending obliquely or nearly transversely from the midrib to the margin of the leaf (fig. 142). These leaves are often scabrous or rugose, especially on the under surface. The arrangement of the flowers too is the same in all these genera; the inflorescence is rarely reduced to a single flower; more usually they consist of simple or ramified panicles of cymes springing from the old wood, the axils of the leaves, or even the axils of slightly developed bracts at the summit of the branches, so that the approximation of several partial inflorescences constitutes what is termed a terminal panicle.[2]

With the same habit and foliage, *Empedoclea*[3] has a single carpel like *Delima* and *Doliocarpus*, containing a placenta on which are six ascending ovules in two vertical rows, and an elongated style stigmatiferous at the tip; indefinite unequal free stamens, of which the dilated connective supports an extrorse anther of two oblique cells, diverging below and dehiscing by longitudinal clefts, and a corolla of three or four petals. But the calyx consists not of five, but of from ten to fifteen sepals, smaller as they are lower down on the elongated cylindrical receptacle on which they are regularly imbricated. Only one species[4] is known, which comes from the south of Brazil.

While in all the species we have just been studying, the (often climbing) stems are woody, and sometimes very much developed, the genus *Acrotrema*,[5] from tropical Asia,[6] consists of small herbs

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[1] DC., *Prodr.*, i. 70.—PL. & TRIANA, in *Ann. Sc. Nat.*, sér. 4, xvii. 15, 23.—SEEM., *Bot. Herald*, 75, 268.—WALP., *Rep.*, i. 65.

[2] In this case they are really racemes whose branches are cymes, usually biparous; but the exhaustion of the vegetation makes them often become uniparous towards the end of the last divisions of the general inflorescence.

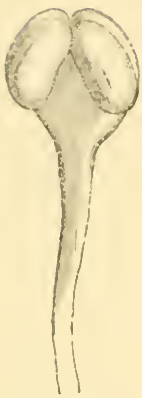
[3] A. S. H., *Flor. Brasil. Merid.*, i. 20, t. iii.—EICHL., *op. cit.*, 82, t. 20.—ENDL., *Gen.*, n. 4762.—B. H., *Gen.*, 11, n. 1 (nec RAFIN.).

[4] *E. alnifolia* A. S. H., *loc. cit.*

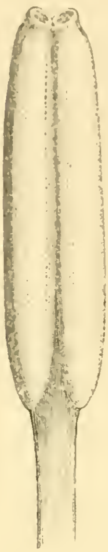
[5] JACK, *Mal. Miscell.*, ex HOOK., *Bot. Misc.*, ii. 81.—WIGHT & ARN., *Prodr.*, i. 6.—ENDL., *Gen.*, n. 4758.—B. H., *Gen.*, 13, n. 7.—H. BN., *Adansonia*, vi. 277, 280.

[6] WIGHT, *Illustr.*, t. 3.—HOOK., *Icon.*, t. 157; *Kew Journ.*, viii. t. 4; *Bot. Mag.*, t. 5373.—

with running rhizomes, from which short branches rise to the surface, bearing a rosette of leaves and axillary peduncles, which bear a single flower, or several grouped into a simple or compound raceme. The calyx consists of five equal or unequal sepals of imbricated, usually quincuncial æstivation. The stamens are indefinite, hypogynous, and become smaller as they are more external. The filaments are free, sometimes collected in three or four distinct groups; they are dilated above into an elongated flattened connective bearing an anther with two linear cells dehiscing laterally or nearly so;[1] or else the filament swells into a short head, which, as in *Acrotrema*, bears the oblique distinctly introrse anther-cells[2] diverging below; or, again, each of the elongated anther-cells opens by a round pore near its tip.[3] The carpels are two in number, free, or slightly coherent towards the base. The ovary contains on its inner angle a placenta which bears either ascending ovules, or two vertical rows of nearly horizontal ovules. The style, often elongated and bent on itself in the bud, ends in a more or less swollen stigmatiferous head. The fruit consists of two or three capsules dehiscing irregularly to free the curved seeds, which possess a membranous



Acrotrema Thwaitesii.
FIG. 151.
Stamen.



Acrotrema costatum.
FIG. 152.
Stamen.

WALP., *Rep.*, i. 65; *Ann.* iv. 36.—HOOK. & THOMS., *Fl. Ind.*, i. 64.—THWAITES, *Enum. Pl. Zeyl.*, 2.—MIQ., *Fl. Ind. Bat.*, i., pars alt., 10.

[1] This is especially seen in *A. lyratum* HOOK. F. (THWAIT., *op. cit.*, 3), in which the filament, not swollen at the summit, is directly continuous with the connective, and bears two adnate narrow cells of lateral or slightly extrorse dehiscence. The outer stamens are shorter than the others, but all are fertile. The carpels, often three in number, contain numerous ovules, and possess a style dilated at the tip.

[2] As in *A. Thwaitesii* HOOK. F. (*A. pinnatifidum* THW.), the top of the filament swells into a connective bearing two oblique ellipsoidal cells diverging at the base and dehiscing marginally or nearly so. In form these anthers (see fig. 151) recall those of most *Tetraceras*. There are usually three carpels, with half a score of ovules in the ovary, and a subulate style not dilated at the tip.

[3] This occurs in the typical species *A. costatum* JACK. The stamens, somewhat unequal, bear an elongated anther which at first appears introrse, but the cells of which only open at the tip by pores with thickened edges (fig. 152)—a character of little value (see p. 114). The sepals are lanceolate, covered with stiffish hairs. The carpels are often two in number; the style is not dilated at the tip. The ovary contains two ascending ovules.

aril, and contain a small embryo within the fleshy albumen.[1] The leaves are nearly entire or dentate, or often pinnatilobed or dissected, recalling forcibly those of some of the Crowfoots or *Potentillas*. The venation is pinnate, with transverse or slightly oblique veins, all parallel. By their flowers the *Acrotremas* are hardly distinguishable from the *Tetraceras*, of which they possess all the essential characters.

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[1] The fruit of *A. Walkeri* WIGHT is surrounded by the calyx and some dried up stamens. It consists of three carpels surmounted by the persistent styles. The seeds are numerous, curved, provided with an aril consisting of a fragile and translucent tissue and chiefly contained in the notch corresponding to the hilum. The testa is covered with little pittings.

III. DILLENIA SERIES.

We must first study the Indian plant *D. speciosa*[1] THUNBG. (figs. 153, 154), which serves as the type of the genus *Dillenia*.[2] Its

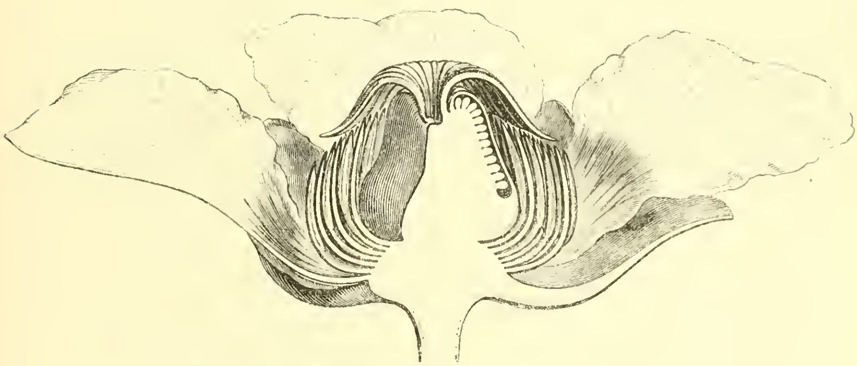
Dillenia speciosa.

FIG. 153.—Floriferous branch.

[1] *Linn. Trans., loc. cit.*— *D. elliptica* THUNBG. *loc. cit.*— *D. indica* L., *Spec.*, 745.— *Syalita* RHEED., *Hort. Malab.*, t. 38, 39.

[2] L., *Gen.*, n. 688.—THUNBG. *Linn. Trans.*, i. 200, t. 18, 19.—DC., *Prodr.*, i. 75.—SPACH, *Suit. à Buff.*, vii. 422.—ENDL., *Gen.* n. 4749.—

broad hermaphrodite flowers possess a convex receptacle on which are successively inserted a calyx of five sepals quincuncially imbricated in the bud, a corolla of five alternate petals of imbricate æstivation, an indefinite number of hypogynous stamens, and a gynæceum composed of numerous carpels. Each stamen consists of a free filament, and a bilocular anther, the linear cells of which,



Dillenia speciosa.
FIG. 154.
Longitudinal section of flower.

adnate for their whole length to the borders of the elongated connective, open near the summit by a cleft which extends downwards to a variable extent.[1] The gynæceum consists of an ovary with a thick central column, surrounded by from twenty to thirty cells which are free only for a very short distance from the summit at the inner angle, each tapering above into a narrowly lanceolate, flattened style reflexed on the summit of the ovary, and stigmatiferous on its inner surface. In the internal angle of each cell is seen a longitudinal placenta supporting an indefinite number of anatropous ovules. The fruit is a large indehiscent berry, with a

B. H., *Gen.*, 13, n. 10.—H. BN., in *Adansonia*, vi. 281; vii. 93, t. iii.—*Songium* RUMPH., *Herb. Amb.*, ii. t. 45, 46.—*Syalita* H. M., ex ADANS., *Fam.*, ii. 364.

[1] We have seen in *Dillenia* the anthers opening by two clefts near the summit which afterwards spread downwards. In *Wormia*, on the contrary, it is generally stated that the dehiscence of the anther is biporricidal. This is too absolute an assertion for several reasons: first, because there are species of *Wormia* in which the dehiscence is by an opening at the summit common to both cells (fig. 157); and secondly, because the openings called pores are short clefts in the species from Madagascar, and may be prolonged for a variable distance downwards towards the base of the anther, as in *Dillenia* proper.

pericarp of no great thickness, surrounded by the persistent calyx, which becomes fleshy. Within, imbedded in a soft pulp, are numerous seeds, whose integuments are covered with hairs at the margin, and contain a small embryo near the apex of the fleshy albumen. *D. speciosa* is a fine tree with alternate, oval-acute dentate, penninerved leaves, the secondary nerves oblique, projecting, parallel. The flowers are solitary terminal.

As a separate genus near *Dillenia* was formerly placed *Colbertia*,[1] which only differs from it in two unimportant points. The flowers, smaller than those of *D. speciosa*, either solitary or in bunches, have yellow, instead of white petals. The seeds, either imbedded in a soft pulp or surrounded by a thin pericarp, have no hairs on the

Wormia bracteata.

FIG. 155.
Flower.

FIG. 156.
Longitudinal section of flower.

surface. The number of cells in the ovary may be reduced to five, as in the species hence named *D. pentagyna*.[2] The ovules horizontal, or more or less ascending, are arranged in two or more rows in each cell. Thus limited,[3] the genus *Dillenia* includes eight or ten species which grow in India, and the neighbouring portions of the Indian archipelago.[4]

The genus *Wormia*[5] is also very near *Dillenia*, from which it has

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[1] SALISB., ex DC., *Syst.*, i. 435.—SPACH, *Suit. à Buff.*, vii. 425.—ENDL., *Gen.*, n. 4747.

[2] ROXB., *Pl. Coromand.*, i. 21, t. 20.—*Colbertia coromandeliana* DC., *Syst.*, i. 435; *Prodr.*, i. 75.

[3] *Dillenia.* Sections 2. { 1. *Eudillenia.* Corolla white; margins of seeds hairy. 2. *Colbertia.* Corolla yellow; seeds glabrous. }

F. MUELLER has lately described (*Fragm.*, v. 175) a *D.* (*Synarrhena?*) *Andreana*, an Australian species with a pale blue corolla.

[4] WALP., *Rep.*, i. 63; ii. 746; *Ann.*, i. 14; iv. 33.—WALL., *Pl. Asiat. Rar.*, t. 22, 23.—HOOK. & THOMS., *Fl. Ind.*, i. 69.—BL., *Bijdraj.*, 6.—MIQ., *Fl. Ind. Bat.*, i. pars alt., 11.—THWAIT., *Enum. Pl. Zeyl.*, 4.—WIGHT, *Illustr.*, ii. t. 358.

[5] ROTTB., *Nov. Act. Hafn.*, ii. 522, t. 3, ex DC., *Syst.*, i. 433; *Prodr.*, i. 75.—SPACH,

been separated, and to which some day, perhaps, it will have to be restored. The calyx consists of five imbricated sepals which persist and grow thick around the fruit. The petals[1] are imbricated, and the stamens free and equal, or smaller as they are more external. The anther cells, marginal or slightly introrse, dehisce near the summit by pores or very short clefts. The number of carpels varies. When there are but five, as in *W. bracteata*, Hook. F. & Thoms., they are opposite the petals. The central axis uniting them touches each only along a narrow, nearly vertical, line;[2] whence the cells of the ovary, multiovulate as in *Dillenia*, are separated by a double wall and a deep sinus (fig. 158). The carpels, the walls of which are membranous, or thick and coriaceous when ripe, remain indehiscent, or dehisce along the inner angle to free the seeds which possess thick coats covered by the fleshy aril, and copious fleshy albumen with a small embryo near its apex.[3]

In certain species of *Wormia* the innermost stamens, much longer than the others, are reflexed and bent down under the styles; these have been erected into a genus under the name of *Capellia*.[4] In others, which there is no need to separate further generically, the outermost stamens become sterile staminodes.[5]

Wormia ferruginea.
Fig. 158.
Transverse section of gynæceum.

Wormia retusa.
Fig. 157.
Stamen after dehiscence.

This genus consists of trees, natives of tropical Asia, Oceania[6]

Suit. à Buff., vii. 413.—Endl., *Gen.*, n. 4750.—B. H., *Gen.*, 13, n. 9.—H. Bn., *Adansonia*, vi. 281.—*Lenidia* Dup.-Th., *Gen. Madag.*, n. 57.

[1] Gaudichaud has described (*Uranie*, 476, t. 99), a *Wormia apetala*, the flowers of which he describes as absolutely apetalous. We have seen authentic specimens of this species, but in such a condition that we were unable to say whether the petals were absent before the expansion of the flowers.

[2] Perhaps this line really answers, not to the internal angle, but to the organic base of the carpel. In this respect, the gynæceum of *Wormia* is no doubt comparable to that of *Nigella* or *Magnolia*, in which the line of insertion of the carpels is also much extended vertically.

[3] Griffith (*Icon. posth.*, t. dclxix.) has represented the seed of his *W. suffruticosa* with its albumen and coats slightly curved towards the apex.

[4] Blume, *Bijdraj.*, 5.—Endl., *Gen.*, n. 4746.—Walp., *Ann.*, iv. 34.—A. Gray, *Amer. Explor. Exped.*, 15, t. i.

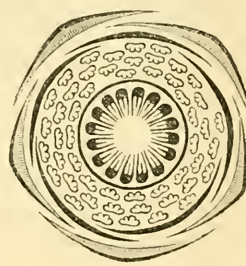
[5] This occurs, but not constantly, in a new species from Madagascar, which we have named *W. ferruginea* (see *Adansonia*, vi. 268, vii. 343), which may be distinguished at first sight by its unilateral inflorescence, and the rust-coloured hairs with which every part is coloured.

[6] Miq., *Ann. Mus. Lugd.-Bat.*, i. 315, t. 9.—Seem., *Fl. Vitiens.*, i. 3.—Benth., *Fl. Austral.*, i. 16.

and Madagascar. Their leaves are alternate, usually glabrous, more rarely covered with hairs; the blade is entire or slightly incised on the margin, with the secondary ribs obliquely parallel, very marked; the petiole is dilated laterally into a pair of membranous caducous wings which have been considered as stipules.[1] The large flowers are solitary, or grouped in terminal pseudo-racemes.

Reifferscheidia,[2] from the Philippine Islands, has all the characters of vegetation and inflorescence of *Wormia;* but the calyx consists of more than five sepals; as many as twelve or fifteen may be counted, imbricated, becoming smaller as they are more external. This unimportant character leads us to consider the single species only a section of the genus *Wormia*.[3]

We cannot consent to remove any further from the genus *Dillenia* that of *Actinidia*,[4] which has by some been referred to the *Tern-*



Actinidia strigosa.

Fig. 159. Flower.

Fig. 160. Diagram.

strœmiaceæ,[5] but which possesses a floral organization so nearly that of *Dillenia* that we may say it only differs in the form of the anthers. Thus in the flower of *A. strigosa* (figs. 159–164) we find a calyx of five quincuncially imbricated sepals, free, or cohering slightly

[1] We have shown (*Adansonia*, vi. 271) how it is hardly possible to give different names in *Wormia* and *Magnolia* to the broad lateral expansions of the petiole, which fall after a certain time, and which extend to the branch, and so leave on its surface, above the insertion of the petiole, an oblique scar, exactly like those which usually indicate the previous existence of supra-axillary stipules.

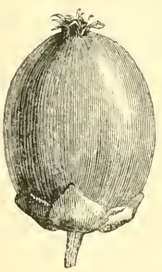
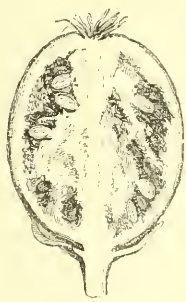
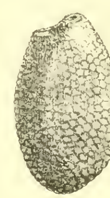
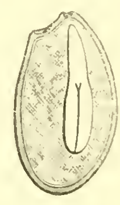
[2] Presl., *Reliq. Hank.*, ii. (1835), 74, t. 62.—Endl., *Gen.*, n. 4748.—B. H., *Gen.*, 13, n. 11.

[3] *Wormia luzonensis* H. Bn. (see *Adansonia* vi. 270).—*R. speciosa* Presl.—*Palali* Luzonensibus, ex Presl., *loc. cit.*

[4] Lindl., *Introd. Nat. Syst.*, 2nd ed., 439.—Endl., *Gen.*, p. 841.—Walp., *Rep.*, v. 131; *Ann.*, i. 15. — *Trochostigma* Sieb. & Zucc., *Abhandl. Akad. d. Wissensch. Munch.*, iii. 726, t. ii. f. 2.

[5] Benth., *Journ. Linn. Soc.*, v. 55.—B. H., *Gen.*, 184, n. 14.

towards the base. The five petals alternating with these, are also imbricated in the bud. The indefinite hypogynous stamens each consist of a free filament, and an extrorse 2-celled anther, more or less versatile on the summit of the filament, and dehiscing longitudinally.[1] The gynæceum is free; it consists of a thick central axis surrounded by from twenty to thirty cells, each surmounted by a spreading style reflexed on the top of the ovary, and stigmatiferous on the upper and inner surface. In the internal angle of each cell is a placenta bearing numerous anatropous ovules. The fruit, which is surrounded by the persistent calyx, becomes a multilocular berry, the pulp of which contains numerous seeds with thick coats[2] and abundant fleshy albumen, surrounding a central elongated embryo with small cotyledons.[3] In other *Actinidias* the flowers often become polygamous, by abortion of the gynæceum.

Actinidia strigosa.

FIG. 161. Fruit.

FIG. 162. Longitudinal section of fruit.

FIG. 163. Seed.

FIG. 164. Longitudinal section of seed.

They are shrubs, often creepers, twining, with alternate simple penninerved leaves. The flowers are axillary to the leaves, solitary,

[1] The anther is extrorse after anthesis; it is also distinctly so in the young buds of *A. rugosa.* The difference between the stamen, as enclosed in the bud, and that of the expanded flower, is that the top of the filament is quite straight before expansion, while afterwards it is bent twice on itself before giving attachment to the connective. In the flowers of *A. strigosa*, the anthers are also extrorse. The connective is narrow and entire above, but bifurcated towards the base of the anther; and as its branches diverge below, so do the cells of the anther.

[2] These seeds have no aril; a character cited by several authors (BENTHAM & HOOKER among others) to justify the separation of *Actinidia* from *Dilleniaceæ*; but we have elsewhere (*loc. cit.* 258) called attention to the fact that in *Dillenia* itself the seeds may want an aril.

[3] This embryo is straight, and more developed than that of most *Dilleniaceæ*, which is at the apex of the albumen. This is another of the characters which removes *Actinidia* from these; "*ob embryonem magis evolutum,*" say BENTHAM & HOOKER (*op. cit.* 11). We do not ascribe much importance to this character. But the affinities of *Actinidia* with *Saurauja*, of the order *Ternstrœmiaceæ*, are incontestible.

or more frequently in pseudo-corymbs. Seven or eight species are known, from China[1] and Japan,[2] India, and the neighbouring countries. We may define them as *Dillenias* with small flowers and versatile, not adnate, anthers.

All the *Dilleniaceæ* we have enumerated, like the *Ranunculaceæ*, possess but few absolutely constant characters in common, and in this order even the number of stamens is not always large and strictly indefinite. But they possess a certain number of other characters, to which their very frequent occurrence imparts a value; the alternation of the leaves,[3] the polypetaly of the corolla,[4] the independence of the elements of the gynæceum,[5] the hypogynous insertion of the stamens and perianth,[6] the persistence of the calyx around the fruit,[7] and the presence of an aril at the base of the seeds.[8] We should also add that the flower is nearly always quite regular, and that the exceptional irregularities observed are usually not constant even throughout the genus, and are limited to a single verticil,[9] the regularity of the general plan of the flower not being otherwise affected.

The most striking characters among those which are variable, and are chiefly used to establish the great subdivisions of the Order, are as follows: the independence, or greater or less union of the elements of the gynæceum; the situation, and definite or indefinite number of those of the androceum. The direction of the anthers and consistency of the pericarp are characters so variable that they can only serve to found the ultimate divisions of genera, or even species.

We learn from R. Brown,[10] that the first idea of making a

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[1] Bentham, *Fl. Hongkong.*, 26.—Pl., in *Hook. Journ.*, vi. 303.—Walp., *Ann.*, i. 15.

[2] Siebold & Zucc., in *Abhandl. der Akad. d. Wissensch. Munch.*, iii. 727, t. ii., f. 2.

[3] In the *Hemistemmas* of Madagascar, the leaves are often opposite.

[4] One *Wormia* alone is, as it appears, apetalous (see p. 109, note 1).

[5] *Dillenia*, *Wormia*, and *Actinidia*, would be the only exceptions.

[6] Perigyny is slightly indicated in *Hibbertia grossulariæfolia* (see p. 94, fig. 134).

[7] Some *Actinidias* seem to be the only exceptions.

[8] *Actinidia* and several *Dillenias* have seeds without any true aril.

[9] Thus the *Delimas* have a single excentric carpel; but the rest of the flower is regular. Certain species of *Tetracera, Davilla*, &c., have an irregular corolla, owing to the suppression of some of the petals, but the other whorls remain regular. *Pleurandra* and *Schumacheria*, possess an irregular androceum, the flower being otherwise that of *Hibbertia* or *Tetracera*. Never is the irregularity sufficiently decided or extended over a sufficient number of parts to give it a generic value. In the calyx of *Davilla* the irregularity does not even appear before a certain period, while the calyx still remains symmetrical with regard to a single plane.

[10] *Gen. Remarks on the Botan. of Terra Austr.*, 9.

distinct order for *Dilleniaceæ* is due to SALISBURY,[1] who proposed to separate them from the *Magnoliaceæ* of JUSSIEU. Of this family LINNÆUS only knew *Tetracera*, *Delima*, *Curatella*, and *Dillenia*; in his time the Australian species had not been studied. ADANSON,[2] who was only able to observe the Linnæan genera, was, as we have already shown,[3] the first to discover the true affinities of the *Dilleniaceæ*, those now recognised by all botanists; putting them at the same time near *Ranunculaceæ*, *Magnoliaceæ* and *Cistineæ*. A. L. DE JUSSIEU[4] knew a larger number of genera which he scattered more, putting *Dillenia* and *Curatella* with *Magnoliaceæ*, *Delima Tetracera* and *Tigarea* among *Rosaceæ*, and leaving *Soramia* of AUBLET and *Doliocarpus* of ROLANDER among his "*Genera incertæ sedis.*" To the genera then known ROTTBŒL added *Wormia* in 1783; VAHL added *Schumacheria*, and VANDELL, *Davilla*. LABILLARDIÈRE and R. BROWN first studied the Australian types, and created, the former *Pachynema*, the latter *Candollea* and *Pleurandra*. DE CANDOLLE added another Australian genus, *Adrastæa*, while A. DE SAINT-HILAIRE discovered the genus *Empedoclea* in Brazil. Finally, to the English botanists JACK, ANDREWS, and LINDLEY, we owe the foundation of the genera *Acrotrema*, *Hibbertia*, and *Actinidia*, which raised to thirteen the number of genera we now admit in the order *Dilleniaceæ*.

This is another order "*par enchaînement.*" DE CANDOLLE[5] divided it into two tribes, putting in the first, *Delimeæ*, most of those species which JUSSIEU had made *Rosaceæ*, and uniting *Dillenia*, *Wormia*, and those Australian genera which were just then being studied, into the second tribe, *Dillenieæ*. This subdivision of the family was adopted by most botanists, especially LINDLEY,[6] who placed among the *Dillenieæ* his genus *Actinidia*, and also *Sauraja*,[7] now referred by most botanists to the *Ternstrœmiceæ*, besides *Tetracarpæa*,[8] one of the *Saxifrageæ*. J. G. AGARDH[9] distinguished among the *Dilleniaceæ* the types analogous to *Wormia*, whose close analogies to *Magnoliaceæ* he recognised; and the *Hibbertiaceæ*, of which he confirmed the relations with *Cistineæ*, *Tremandeæ*, and

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[1] *Paradis. Lond.*, 73.
[2] *Fam. des Plantes*, ii. 364, 442, 450.
[3] *Adansonia*, vi. 272.
[4] *Genera Plantarum*, 282, 339, 433.
[5] *Syst. Veg.*, i. 359; *Prodr.*, i. 67.
[6] *Veg. Kingd.*, 424. ENDLICHER, *Gen.*, 840, subdivides this order in the same way.
[7] W., *Neue Schr. Ges. Nat. Berl.*, iii. 406.
[8] HOOK. F., *Hook. Icon.*, t. 264.
[9] *Theor. System. Plantar.*, 200.

Pittosporeæ. Finally, BENTHAM & HOOKER[1] have recently divided the order into three tribes, *Delimeæ*, *Dillenieæ*, and *Hibbertieæ*,[2] based on the form of the anthers. We have elsewhere attempted to show[3] how this classification, often serviceable in practice, is yet by no means exact, and how the same form of stamen may be observed in genera of any of the three tribes indifferently. Hence we have tried to establish a certain number of series, of which the respective genera have been described above, and which are founded first on the general structure of the gynæceum, and then on that of the androceum. *Dillenia* is in our eyes the prime centre around which are grouped the genera in which the carpels are more or less united into a plurilocular ovary, while at the same time the stamens are indefinite. In all the other *Dilleniaceæ* the carpels are independent of one another, and the unilocular ovaries have a parietal placenta in the inner angle. But among these the stamens may be indefinite as in *Hibbertia*, or twice as numerous as the petals, or grouped in exactly as many bundles as there are pieces in the perianth, as occurs in *Candollea*. Thus *Hibbertia* and *Candollea* become two other centres or heads of series, usually easy to separate in practice, but between which we should be the first to recognise that there are inevitable points of contact, such as are always found in orders like the one under consideration.[4]

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[1] *Genera*, 10, 11.

[2] PLANCHON has reproduced (see *de Linden*, 3, 4) the opinions of the English authors, and admitted their three principal groups; but he makes a fourth for the genera *Wormia*, *Acrotrema*, and *Schumacheria*, which, he says, "are more or less abnormal, and do not fit well in any of the divisions." We have shown (*Adansonia*, vi. 276) in what this assertion is too absolute, and how closely analogous are *Wormia* and *Dillenia*, *Schumacheria* and *Hemistemma*, *Acrotrema* and *Tetracera*, at least in flower and fruit.

[3] *Adansonia*, vi. 269, 278. In several *Tetraceras* and *Davillas* the same flower contains one- and two-celled extrorse and introrse anthers. We have been shown several flowers of *T. senegalensis*, which had introrse anthers to the inferior stamens, while all the superior or innermost stamens had extrorse anthers. In *T. obovata*, the summit of the filament swells into a connective of variable form, sometimes entire, sometimes bifid to a variable extent; the cells are then borne on distinct branches (fig. 143). In *T. volubilis*, the stamens are all unlike. The connective swells gradually, or suddenly, into an obpyramidal, or club-shaped head (fig. 144); the outermost stamens, very short, may be quite sterile. In *T. sarmentosa*, the filaments are free, or slightly coherent at the base. In *Davilla rugosa* we have seen introrse and extrorse anthers in the bud. *Acrotrema*, which is said to have "*Staminum filamenta haud dilata*," may have parallel marginal anther cells, or a connective swollen into a head like *Tetracera* (fig. 151), or the anther cells may be porricidal and close together for their whole length (fig. 152). The *Hibbertias*, in which the cells are long, narrow, parallel, and close together (fig. 130), may have anthers with short, dilated connectives, and short cells, like those of *Tetracera* (see fig. 131). Such occurrences have been pointed out by F. MUELLER (*Fragm.*, ii. 2), especially in *H. stellaris*, of which the anthers are broader than they are long.

[4] Thus we have shown how the *Hibberlieæ* and the *Delimeæ*, come through *Trisema* and *Delima* respectively to present the same perianth, the same androceum with indefinite elements, and the same gynæceum. We have also recognised the common links between *Acrotrema* and *Schumacheria*, and the *Dillenieæ*, *Tetracereæ*,

Few of the *Dilleniaceæ* are herbaceous; none but a few of the *Hibbertias*, especially *H. grossulariæfolia*, and also the *Acrotremas*, which in habit and by their simple leaves, entire, pinnatisect, or lyrate, resemble certain *Ranunculaceæ* or *Fragarieæ*. Nearly always the branches are woody, at least towards the base; they are often also trailing and twining. CRÜGER[1] has studied the anatomy of several of these lianas, especially of *Doliocarpus Rolandri* and *Curatella*. But the only character made out in these plants has been an abnormal arrangement of the vascular bundles, which seems simply to depend on their sarmentose nature, and is found in the lianas of many other orders; namely, the very clear marking out of the different concentric zones of wood, and the frequent occurrence of supplementary woody bundles, quite isolated in distinct parts of the cellular matrix which constitutes the medullary rays and cortical parenchyma. No one, hardly, had investigated the anatomical characters common to all those *Dilleniaceæ* which have not a climbing stem; and we think it right to reproduce here the facts we have recently published[2] on the subject.

"All the *Dilleniaceæ* are rich in bundles of raphides. In the cultivated *Candolleas* and *Hibbertias* we find them abundantly in the cortical cells, the pith, and the parenchyma of the leaves. In the pith of *Dillenia speciosa*, THUNBG., are found cells containing enormous packets of these crystalline needles. All the other cells, and often the woody fibres also, are at certain seasons gorged with starch granules, which here, as in *Candollea*, *Hibbertia*, and so many other woody plants, are secreted and re-absorbed to subserve nutrition—a fact too general, and known too long to be worth dwelling long upon here. In all the Australian species we have examined

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and *Pleurandreæ*. We know well, too, that *Candollea* and *Hibbertia* are closely related, for there are *Hibbertias* with oligandrous bundles when adult, like *H. lepidota* R. BR., that form a transition between them; and C. J. DE CORDEMOY has shown (*Bull. Soc. Bot. Fr.*, vi. 450) how likely it is that the two types will some day be fused into one. It is further very well known that organogenic researches have shown in both genera the existence of distinct alternipetalous bundles, and that the clear distinction into these bundles is no longer visible in the adult flower of *Hibbertia*, simply because of the immense multiplication of the elements of each. It is nevertheless true that there is really in practice no hesitation in distinguishing a *Hibbertia* from a *Candollea*. If there were doubtful cases, it would prove that our classifications are perfectible, and are always wrong in putting forth an absolute claim to the title "natural;" but so far as we know, none avoids this inconvenience.

[1] *Einiger Beiträge z. Kenntniss von sogenannten anomalen Holzbildungen des Dicotylenstammes* (*Bot. Zeit.*, 1850, 166, t. iv).

[2] *Comptes Rendus de l'Académie des Sciences*, lxiv. 297; *Adansonia*, vii. 88.

the starch granules are irregularly rounded, and of very unequal size. In most species of *Wormia* the pith becomes hollowed when at a certain age, forming nearly parallel septa or leaving a cavity of irregular form. The pith, though much flattened, is not wanting in the species with cladodia analogous to those of *Xylophylla*, and especially in those of the genus *Pachynema;* here the fibro-vascular woody bundles are naturally nearly parallel, diverging towards the pulvinus so as to simulate the lateral ribs of a leaf.

"The most remarkable feature in the structure of the *Dilleniaceæ* is the frequent occurrence of fibres with areolate punctations,[1] the areolæ surrounding the perforations being found in every degree of development, according to the age and species of the specimen. Thus in a very young herbaceous branch of *Dillenia speciosa,* we only find common woody fibres, accompanied in every bundle by vessels of all kinds, especially cylindrical vessels with very thin walls, strengthened by pretty thick parallel rings at long intervals, and also true or false tracheæ, in which we often see the spiral thread become single for a variable distance, although there are most usually two distinct parallel cords. At this period the cortical parenchyma is very rich in tubular cells of the herbaceous layer, full of enormous chlorophyll granules, and the liber fibres show minute punctations. The suber is formed of a fine compact cellular tissue; the epidermis is covered with simple hairs, swollen, and, as it were, geniculate at the base. On a distinctly woody branch of the thickness of the finger all the punctations of the cells and fibres have assumed quite another character. The cells of the medullary rays, full of starch inside, communicate with one another extensively by cylindrical canals, punched, so to speak, in their very thick walls. On the walls of the woody fibres the canals have the form of a truncated cone with the small end outside; two of these truncated cones, at exactly the same level on two adjacent fibres touch by these small ends; and it is at the junction on a level with the contracted part of the sort of hourglass thus formed that the lenticular cavity is placed, easily seen on making a longitudinal section. But when seen in front, it appears as it does in the Conifers, as a very dark, circular or elliptical spot, surrounded by the con-

[1] [Or so-called "glandular woody fibre."—TRANS.]

centric areola due to the presence of the canal which abuts on this perforation. In *Candollea* and *Hibbertia*, we find the same general arrangement of the pores, but the areola is more or less distinct according to the species, so that we find every intermediate stage between ordinary non-areolate pores, and pores with large areolæ. This also occurs in *Curatella*, *Schumacheria*, and as is rather remarkable, in *Actinidia*, whose affinities to the *Dilleniaceæ* are not recognised by all botanists; in *A. callosa* especially, the pores are very distinctly areolate. Most usually these pores are arranged in two opposite vertical rows in each fibre. When the punctations and areolæ are quite circular, we can superpose those of one row on those of the other, so exactly that only one set of punctations is seen. But when they are elliptical, as frequently occurs in *Dillenia* and *Candollea cuneiformis*, the black elongated spots formed by those of one row may slant in a different direction to those of the other; so that seen by transmitted light the two spots form a little St. Andrew's cross, with four nearly equal branches very regularly arranged.

"In the young branches of some of the *Candolleas* the liber fibres are relatively very large, separate from one another, and few in number. In several *Hibbertias*, another element of the bark, the cellular tissue, is greatly developed. But this sort of hypertrophy only occurs on two sides of the stem, which thus becomes flattened, with two projecting angles; the wood is not affected by this deformity, which has no relation to that which produces the cladodia described above.

"The leaves have usually a heteromorphous parenchyma; the cells beneath the superior epidermis are rod-shaped, and of nearly equal size; but they become irregular next the inferior epidermis, which consists of cells of very irregular contour, and bears stomates, which are elliptical in *Dillenia*, *Candollea*, &c. We have said that the parenchyma often contains bundles of raphides; these, projecting from the organs, give the leaves of most *Dilleniaceæ* the property of becoming rough to the touch when dry. This roughness, not without its practical utility, is due in several species to a somewhat different cause. Some *Dilleniaceæ*, especially the *Curatellas*, are known to possess leaves so rough and rasping, as to be used in several countries of tropical America for polishing even metals. This is due to the accumulation in the leaves of a large number of

concretions of peculiar form and siliceous nature, which are not attacked by any but fluorhydric acid. We will study them in *C. americana,* which is rough on both surfaces. Above, this is entirely due to the projection of these numerous projections seated under the superficial layer of epidermis; they are globular, of unequal size, studded with minute tubercles like a cauliflower. They may be compared to the cystoliths of *Urticaceæ* and certain *Euphorbiaceæ;* they are probably less prominent in fresh leaves. The inequalities of the lower surface are due to several causes. First, the nerves project and form here a very rich network, making it goffred as it were. Secondly, these nerves bear two kinds of projections on their surface: stellate hairs, and concretions like those of the upper surface, but smaller and more distinctly tuberculate. The hairs consist of rays without septa, tolerably acute and soft; only at the base is there sometimes a certain degree of rigidity. The concretions are very hard all over, but often their lobes, more acute and projecting than usual, are less rigid and more transparent, so that we find a sort of transition between the superficial stellate hairs and the stony deposits of the inferior epidermis. These concretions are found abundantly, though of yet smaller size, in the areolæ or meshes of the veins; here, too, the epidermis also presents a few small stomates. Here and there are quite simple hairs. In certain *Tetraceras* these are very numerous and quite simple; in the leaves of *Delima sarmentosa* we find some very flexible at the apex, but whose thickened base has become hard through the deposition of the stony substance we so often meet with in *Dilleniaceæ.*"

AFFINITIES.—We have seen[1] that ADANSON first recognised the complex affinities of the *Dilleniaceæ* with *Cistineæ, Magnoliaceæ,* and *Ranunculaceæ;* it is beside the last two that most modern botanists have agreed to place them. We have elsewhere stated[2] that the *Dilleniaceæ* represent *Ranunculaceæ* with the stem usually woody, the calyx almost constantly persistent round the fruit, and the seeds usually arillate. When the ovules are of limited number and ascending in *Dilleniaceæ,* the micropyle is at first turned down-

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[1] See p. 113. [2] *Hist. des Plantes,* 70; *Adansonia,* iv. 36; vi. 273.

wards and inwards, while it looks outwards in all *Ranunculaceæ* with ascending ovules as yet known. Nevertheless, by making use of these characters we can only distinguish *Ranunculaceæ* and *Dilleniaceæ* approximatively. But one fundamental difference, difficult however to make out in the adult flower, has been established by the study of their organogeny. The evolution of the androceum is centripetal in *Ranunculaceæ*, but centrifugal in all *Dilleniaceæ* as yet observed.[1] The *Dilleniaceæ* have, moreover, incontestible affinities with numerous orders of plants with unilocular or plurilocular ovaries. The Australian types analogous to *Hibbertia* and *Candollea* are evidently allied to *Cistineæ*[2] and the neighbouring orders, especially to *Bixaceæ*.[3] On this matter we have expressed our opinion[4] that "the floral organization of certain *Bixaceæ*, as *Mayna*, *Carpotroche*, &c., leads us to think that the order *Dilleniaceæ* might well have representatives scattered through several groups with one-celled ovaries and parietal placentation, and that in these will perhaps some day be found types bearing the same relation to *Hibbertia* or *Tetracera* that *Monodora* bears to *Anonaceæ*, *Berberidopsis* and *Erythrospermum* to *Menispermaceæ* and *Berberideæ*, or *Papaveraceæ* to *Ranunculaceæ*." As the right of *Monodora* to a place among *Anonaceæ* is no longer contested, it is probable that the opinion of MIERS,[5] who ranks *Canellaceæ* among *Winteraceæ*, will, sustained as it is by such good arguments, be also unreservedly accepted before long. Then it will not be forgotten that, on the one hand, BENTHAM & HOOKER[6] have recently put forth clearly the close affinities of *Canella* and *Samyda*. And as these last are actually placed by the same authors in the same order with the *Banareæ*, formerly considered as inseparable from *Bixaceæ*, it will be seen that to take into account all the affinities of a large order consisting of *Bixaceæ* and *Samydaceæ* both,[7] we should place it at the same time near to the *Canellaceæ* (a part of *Magnoliaceæ*), and to those types with parietal placentation that recall the *Dilleniaceæ* in most of their characters. This would explain how it is that *Carpotroche*, confounded with the true *Maynas*, has in many

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1 PAYER, *Traité d'Organogénie comparée de la Fleur*, 233, t. li.; *Adansonia*, iii. 129; vi. 266.

2 ADANSON., *loc. cit.*—AGARDH, *Theor. System. Plant.*, 200.

3 PLANCHON, *Voy. de Linden*, 3.

4 *Adansonia*, vi. 274.

5 *Contributions*, i. 122.

6 *Gen.*, 795, 797.

7 This would be an order in which are united hypogynous and perigynous genera, as the form of the receptacle may be indifferently convex or concave in very many natural orders.

classifications[1] been placed among *Magnoliaceæ* or *Dilleniaceæ*. The difficulty is here the same as with *Erythrospermum*, sometimes referred to the *Bixaceæ*, sometimes to *Berberidaceæ*, according as more stress has been laid on the position and form of the placenta, or on the other whorls of the flower and their symmetry. In this respect, again, the *Dilleniaceæ* touch the *Canellaceæ*, which we include in *Magnoliaceæ*. *Dillenia*, *Wormia*, and other analogous genera come very near *Magnolia* by their leaves with dilated petioles, membranous and stipuliform on the edges,[2] while by the arrangement of their gynæceum, they recall that of *Illicium* and *Drimys*. The number of parts of the flower excepted, *Dillenia* and *Wormia* are, we may say, far more like *Magnolia* than like most *Dilleniaceæ* of the *Candollea* group. The way the indefinite stamens are inserted on the receptacle of the flower, the very position of the flower at the end of the branch, and even the absence of a sacciform membranous aril[3] to the seeds of true *Dillenias*, are features which would have rendered it impossible to place these in a different order from that of *Liriodendron* or *Talauma*, if the structure of the gynæceum, apparently so different, had not been taken into account. But we have shown[4] that the carpels of *Wormia* and the analogous genera are really free like those of *Magnolia*,[5] not united into an ovary whose cells are separated from one another by simple dissepiments; while the styles are distinct from one another towards the base, and are joined only from a certain point, to diverge afresh in the stigmatiferous portion. Thus *Wormia* and *Davilla* serve as a passage towards *Actinidia*, which we cannot remove from them, and which also resembles *Sauraja* so much as to have been placed with it and *Stachyurus* in a separate tribe of the order *Ternstrœmiaceæ*.[6] It has been shown, too, how through this last order the *Dilleniaceæ* are indirectly allied to *Ericineæ*, *Ebenaceæ* and *Pittosporaceæ*. We might also point out some more distant relations between *Schumacheria* and certain *Dipterocarpeæ*,[7]

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[1] Especially in those of JUSSIEU (*Gen.*, 281), DE CANDOLLE (*Prodr.*, i. 79), ENDLICHER (*Gen.*, n. 4734), &c.

[2] See *Adansonia*, vi. 271.

[3] A character of so much importance in the eyes of several authors, that it is, for instance, one of the reasons which has determined the introduction of *Crossosoma* into the order *Dilleniaceæ* rather than *Ranunculaceæ*.

[4] *Sur l'Organisation Florale d'un* Wormia *des Seychelles, Adansonia*, vii. 343. In this memoir it is proved that there is at every age a considerable cavity in the intervals between the ovaries, and that the styles unite above this space.

[5] See p. 109, note 2.

[6] B. H., *Gen.*, 184.

[7] Especially in the venation of the leaves and the unilateral arrangement of the flowers.

between *Hibbertia* and *Papaveraceæ*,[1] and between *Tetracera*[2] and the tribe *Cunonieæ* of the *Saxifragaceæ*.

The geographical distribution of the *Dilleniaceæ* is little complicated. The score of species belonging to our *Candollea* series are of Australian origin,[3] as are nearly all the *Hibbertias*, about eighty in number;[4] two species alone, belonging to the section *Hemistemma*, have been observed in Madagascar.[5] *Dillenia*,[6] *Schumacheria*,[7] *Acrotrema*,[8] and nearly all the *Wormias*[9] are natives of tropical Asia; two species of *Wormia* alone grow in the eastern islands of Africa,[10] and only one in Australia.[11] *Actinidia* has only been observed in China, Japan, and the north of India.[12] *Davilla*,[13] *Empedoclea*,[14] and *Curatella*[15] are three exclusively American genera. *Tetracera*, also very abundant in tropical America,[16] is the genus most widely spread over the globe; it is found in Senegal and Guinea,[17] Madagascar and the east coast of Africa,[18] tropical and eastern Asia,[19] the Indian Archipelago,[20] New Caledonia,[21] and Australia.[22] *Tetracera* (*Delima*) *sarmentosa* is found over a large extent of tropical and eastern Asia.[23] The number of

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1 "It is very singular," we have observed (*Adansonia*, vi. 275), "that certain *Hibbertias*, like *H. volubilis*, have the fœtid smell of Poppies. If we suppose their carpels opened out, and put edge to edge, we have the flower of *Papaver* at once."

2 We need only recall the fact that *Tetracarpæa* has been classed among the *Dilleniaceæ* (see p. 113), and that *Itea* and *Stachyurus* recall forcibly *Clethra*, *Saurauja*, and *Actinidia*.

3 Benth., *Fl. Austral.*, i. 41.

4 Benth., *op. cit.*, i. 17.

5 Dup.-Th., *Gen. Mad.*, n. 18.—DC., *Prodr.*, i. 71, § 1. They might well both be only forms of a single species, *H. coriacea* (*Helianthemum coriaceum* Pers., *Enchir.*, ii. 76).

6 Hook. & Thoms., *Fl. Ind.*, i. 69.—Miq., *Fl. Ind. Bat.*, i., pars alt., 11.

7 Hook. & Thoms., *Fl. Ind.*, i. 65.—Thwaites, *Enum. Pl. Zeyl.*, 4.

8 Thwaites, *Enum. Pl. Zeyl.*, 2.—Miq., *Fl. Ind. Bat.*, i. pars alt., 10.—Hook. & Thoms., *Fl. Ind.*, i. 64.

9 Bl., *Bijdr.*, 5.—Hook. & Thoms., *Fl. Ind.* i. 66.—Miq., *Fl. Ind. Bat.*, i. pars alt., 10; *Ann. Mus. Lugd.-Bat.*, i. 315, t. ix.—A. Gray, *Bot. Exp. Wilk.*, t. i.—Walp., *Rep.*, i. 63; *Ann.*, iv. 34.

10 Poir., *Suppl.*, iii. 330.—DC., *Icon. Deless.*, i., t. 82.—H. Bn., *Adansonia*, vi. 268.

11 Benth. & F. Muell., *Fl. Austral.*, i. 16.

12 Sieb. & Zucc., in *Abh. Akad. Wiss. Mun.*, iii. 726.—Benth., in *Journ. Linn. Soc.*, v. 55.—Walp., *Rep.*, v. 131; *Ann.*, i. 15.

13 Velloz., *Fl. Flum.*, v. t. 116.—A. S. H., *Pl. Us. Bras.*, xxii. xxiii.—Presl, *Rel. Hænk.*, ii. 72.—Seemann, *Herald*, 74, t. xiii.—Pl. & Triana, *Ann. Sc. Nat.*, sér. 4, xvii. 18.—Walp., *Rep.*, i. 66; ii. 746; v. 13; *Ann.*, i. 15; ii. 17; iv. 36.

14 A. S. H., *Fl. Bras. Mer.*, i. 20, t. 3.

15 A. S. H., *Pl. Us. Bras.*, xxiv.—Seem., *Herald*, 75, 268.—Pl. & Triana, *Ann. Sc. Nat.*, sér. 4, xvii. 15, 23.—Netto, *Itin. Bot.*, 16.—Walp., *Rep.*, i. 65.

16 See p. 101, note 2.

17 Guillem & Perr., *Tent. Fl. Seneg.*, 2, t. 1.—H. Bn., *Adansonia*, v. 362.

18 H. Bn., *Adansonia*, vii. 300, t. vii.

19 Hook. & Thoms., *Fl. Ind.*, i. 61.

20 Blume, *Bijdr.*, 3.—Miq., *Fl. Ind. Bat.*, i. pars alt., 8.

21 Labill., *Sert. Austro-Caled.*, 55, t. 55.—Forst., *Prodr.*, 228; *Gen.*, 41.

22 F. Muell., *Fragm.*, v. 1.

23 DC., *Icon. Deless.*, i. t. 72.—Hook. & Thoms., *Fl. Ind.*, i. 61.—Presl, *Rel. Hank.*, ii. 73.—Miq., *Fl. Ind. Bat.*, i. pars alt., 7.—Thwait., *Enum. Pl. Zeyl.*, 1.—Seem., *Herald*, 361.—Benth., *Fl. Hongk.*, 7.—Walp., *Ann.*, ii. 18; iii. 812; iv. 36.

Dilleniaceæ known is in all about two hundred species. Their uses are but few. Most are rich in tannin, and strike an intense black in contact with iron. This is very marked in *Schumacheria*, which might be used in dyeing; it is also found, though in a less degree, in *Tetracera, Davilla, Curatella*, &c. Hence it is not strange that *Curatella americana* and *C. caimbahiba*[1] should be successfully used in tanning hides, and that astringent lotions are made from their bark in Brazil. The decoction of the leaves is used as a topical application to wounds. *Davilla* is used for similar purposes; thus *D. elliptica*, the *Caimbaibinha* of the province of Minas-Novas, serves to prepare a vulnerary of the same name, much prized by the Brazilians.[2] *D. rugosa* is their *Cipo de Caboclo*, or *de Carijo*, of which a decoction is made, which cures swelling of the legs, thighs, &c., affections very common in the warm regions of South America. It is probably also an astringent action that is exerted by *Colbertia obovata* BL. (which is a *Dillenia*), when the juice is mixed with water and used to wash the head to arrest baldness. RHEEDE relates that the acidulous juice of the fruit of *D. speciosa* mixed with syrup is a remedy for coughs. *Tetracera Rheedii*, infused in rice-water, is much used in Malabar as a gargle for aphthæ. A decoction of *T. Tigarea* is prescribed in Cayenne, under the name of "*Liane Rouge*" (Angl. *Red Liana*), as an antisyphilitic.[3] *T. Breyniana* and *oblongata* have the same properties as *Davilla rugosa*, and fumigations of these plants are used in swellings of certain organs. The juice of *Tetracera alnifolia* serves, it is said, as a beverage in Africa. *Dillenia scabrella* and *speciosa* are used for domestic purposes in Malabar. The thickened calyxes, gorged with an acidulous juice, are preserved, and enter into the preparation of acid beverages and stews, almost like the lemon in Europe. With the ley of the leaves plate is cleaned. The *Tetraceras* have often rugose leaves; those of *T. sarmentosa* are used in the Indo-Chinese Peninsula to polish wood, and tin vessels. *Curatella americana* possesses this property in a higher degree, owing to the siliceous concretions found abundantly in its leaves.[4] The

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[1] A. S. H., *Plus. Us. Brasil.*, t. xxiv.—NETTO, *It. Bot.*, 16.

[2] A. S. H., *Pl. Us. Brasil.*, t. xxxiii.

[3] AUBLET, *Guian.*, ii. 921, t. 351.

[4] According to NETTO (*loc. cit.*) this tree is called *Cajueiro bravo* in the campos of North Brazil. "But," says this author, "the name of *Caimbahiba* is preferable as a popular name, it seems to me; for it gives perfectly the idea of the most remarkable property of this vegetable. In fact, *Caimbahiba* means in the aboriginal language 'Shagreen (or glass paper) Tree,' 'Planing Tree,' 'Prickly Tree,' &c., which tallies with the use the natives formerly made and still

Galibis use them to polish their arms, bows, arrows, clubs, &c. The wood of the Indian *Dillenias* is solid and durable; it is used in building, and according to Wight, who also dwells on the beauty of their foliage, and the size of their flowers, they are highly prized as ornamental plants. *D. speciosa* is a magnificent decoration for our conservatories, when, by suitable proceedings,[1] we can induce it to flower. Several pretty *Candolleas* and *Hibbertias* with yellow flowers are also cultivated in conservatories of moderate heat.

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make of it. They use it like glass paper to polish their wooden utensils; and in the northern provinces of Brazil, even the carpenters, unused to the means employed in large towns, use it in their work."

[1] See *Adansonia*, vii. 94.

GENERA.

I. CANDOLLEÆ.

1. **Candollea** Labill.—Flowers 5-merous. Sepals imbricated, persistent. Petals usually 5, alternate with the sepals, variably imbricated deciduous. Stamens united to a variable height into 5 alternipetalous 1–∞-androus bundles (besides single free oppositipetalous stamens, in a few species); filaments free at the apex. Anthers introrse, dehiscing by 2 clefts. Carpels 5, more rarely 3, 4, opposite the petals, 1-, 2-, very rarely 3-ovulate; ovules ascending; micropyle introrse inferior; styles sulcate internally, bearing capitate stigmas. Ripe carpels subcarnose, or more usually dry, and dehiscing as follicles. Seeds 1 or 2, arillate; albumen fleshy; embryo minute.—Shrubs or undershrubs; leaves alternate simple articulated at the base exstipulate; flowers solitary terminal (*S. E. Australia*).—See p. 85.

2. **Adrastæa** DC.—Flowers 5-merous. Sepals imbricated persistent. Petals 5, more rarely 3, 4, alternate with the sepals, imbricated deciduous. Stamens 10, in two whorls, the inner subalternipetalous; filaments flattened cohering at the base; anthers basifixed introrse dehiscing by 2 clefts. Carpels 2; ovules 2, ascending; styles subulate; fruit 2-follicular.—An undershrub; leaves alternate, sessile, articulate; flowers sessile terminal (*W. Australia*). See p. 87.

3. **Pachynema** R. Br.—Flowers 5-merous. Sepals and petals free imbricated. Stamens 9–11, variably arranged, 2 sterile interior club-shaped, usually alternate with the carpels, 7-9 fertile; filaments flattened or club-shaped or conoidal; anthers introrse, dehiscing by 2 clefts. Carpels 2, 2-ovulate; when ripe dry 1-seeded; seed arillate.—Herbs or shrubs; branches rush-like or flattened (cladodia); leaves minute scale-like deciduous; more rarely few, 3-fid; flowers axillary, solitary or few; pedicel recurved (*Australia*). See p. 88.

II. HIBBERTIEÆ.

4. **Hibbertia** Andr.—Flowers 5-merous. Sepals imbricated persistent. Petals 5, more rarely 2–4, alternate with the sepals, variably imbricated deciduous. Stamens ∞, hypogynous or more rarely slightly perigynous, all fertile or some sterile; in some (*Cyclandreæ*) peripheral, in others (*Pleurandreæ*) unilateral; staminodes external, peripheral or unilateral, or more rarely on each side of the fertile stamens, intermixed with them, or internal; anther-cells 2, oblong introrse or lateral adnate to a linear connective, more rarely rotundate, shorter than the connective which is dilated at the apex; dehiscence longitudinal. Carpels 1–∞ (usually 6–10), all free, or more or less adnate at the base to the conical receptacle, 1–∞-ovulate; ovules in 2 rows, ascending or subhorizontal. Fruits dry, usually dehiscing as follicles, or in 2 valves. Seeds 1–8, arillate. —Shrubs, more rarely undershrubs or herbs, sometimes trailing or twining; leaves petiolate or sessile; flowers solitary terminal, or leaf-opposed, or often in unilateral false spikes or racemes (*Oceania, Madagascar*). See p. 90.

5. **Schumacheria** Vahl.—Flowers 5-merous. Sepals imbricated, persistent. Petals usually 5, imbricated. Stamens ∞, unilateral; filaments cohering at the base; anthers erect, spuriously porricidal dehiscing by two short apical clefts. Carpels 2, 3, excentric, 1-ovulate, when ripe dry and indehiscent; seed arillate.—Climbing shrubs; branches flexuous; leaves parallelly penniveined; flowers in one-sided subspicate racemes, with (usually 2) lateral bracts; racemes axillary or terminal, branching (*Ceylon*). See p. 97.

6. **Tetracera** L.—Flowers hermaphrodite, more rarely polygamous. Sepals 3–6 (usually 5) imbricated. Petals 1–6 (usually 5) imbricated. Stamens ∞, peripheral; filaments all free, or aggregated into a few bundles for a variable height; anthers sterile abortive, or more usually 2-celled; cells lateral extrorse or introrse, subparallel or more or less diverging at the base; filaments dilated entire or 2-fid at the apex. Carpels 1–6, free; ovaries 2–∞-ovulate; ovules ascending or subhorizontal. Fruit dry or more or less fleshy, dehiscing as a follicle or in two valves, more rarely inde-

hiscent, 1–∞-seeded; seeds arillate.—Trees or (usually climbing) shrubs; leaves parallelly pennniveined; flowers solitary terminal, or in lateral axillary or terminal cymose panicles (*tropical America, Oceania*, and *Africa*). See p. 99.

7. **Davilla** VANDELL.—Fowers 5-merous. Sepals 5 imbricated, very unequal; the 2 innermost by far the most accrescent, very concave, finally coriaceous, with valvate edges, surrounding the fruit; the other three smaller. Petals 1–5, membranous, imbricated. Stamens ∞ (of *Tetracera*). Carpels 1–3 (more rarely 4, 5), 2-ovulate; when ripe indehiscent or bursting irregularly; seeds arillate.—Shrubs, usually climbing; leaves and inflorescence of *Tetracera;* petioles rarely dilated and winged; flowers in cymose panicles, more rarely solitary (*tropical America*). See p. 101.

8. **Curatella** L.—Flowers 4-, 5-merous. Sepals and petals imbricated. Stamens ∞ (of *Tetracera*); dehiscence longitudinal, almost marginal. Carpels 2, obliquely connate at the base; styles distinct, dilated into stigmas at the apex; ovules 2, ascending. Fruit either subcarnose indehiscent, or dry dehiscing dorsally. Seeds arillate.—Trees or climbing shrubs; leaves (of *Tetracera*) thick; venation parallel pinnate reticulate; flowers numerous in axillary or lateral cymose panicles (*tropical America*). See p. 102.

9. **Empedoclea** A. S. H.—Sepals ∞ (10–15), unequal much imbricated in ∞ rows on the elongated receptacle. Petals 2–4, imbricated. Stamens ∞ (of *Tetracera*), unequal; anthers extrorse; cells inserted obliquely on the dilated connective, dehiscing longitudinally. Carpel 1, pseudo-terminal; ovary 1-celled; ovules not more than 6 in 2 rows, ascending; style capitate. Fruit dry.—Shrub with the habit of *Tetracera;* venation of leaves parallel, pinnate; flowers in bracteate racemose cymes axillary to the leaves or terminating the twigs (*Brazil*). See p. 103.

10. **Acrotrema** JACK.—Flowers 5-merous. Sepals 5, imbricated. Petals usually as many, imbricated. Stamens ∞, either symmetrically peripheral all free, or more rarely more or less aggregated in 3, 4 bundles. Anther-cells either linear adnate introrse or extrorse dehiscing longitudinally, or by terminal pores; or more rarely

inserted obliquely (as in *Tetracera*) on a dilated connective. Carpels 2, 3, free or cohering at the base; styles free more or less thickened and stigmatiferous at the tip. Ovules 2, 3 ascending, or ∞ in 2 rows. Fruit dry, indehiscent or bursting irregularly. Seeds 2–∞, arillate.—Perennial, subcaulescent herbs; leaves alternate close together, pennivcined with transverse venules, entire, or pinnately lobed or dissected; petioles often winged; flowers, axillary pedunculate, solitary or racemose (?) (*India, Ceylon.*) See p. 103.

III. DILLENIEÆ.

11. **Dillenia** L.—Flowers 5-merous. Sepals imbricated, spreading, persistent, becoming fleshy around the fruit. Petals much longer, imbricated. Stamens ∞, nearly free; anthers linear; cells adnate, dehiscing by submarginal clefts. Carpels 5–∞, adhering to the axis, united to each other only by the ventral margin, otherwise free; styles as many, stellately reflexed, stigmatiferous internally. Ovules ∞, in 2 rows, subhorizontal. Fruit indehiscent, subbaccate 5–∞-celled; seeds imbedded in pulp or pulpless, glabrous or hairy at the margin, exarillate.—Trees; leaves large, of parallel pennivenation; flowers solitary or fascicled, lateral or terminal (*tropical Asia, Australia*). See p. 106.

12. **Wormia** Rottb.—Sepals 4–6, more rarely 10–15, unequal, imbricated. Petals 5 imbricated, or 0. Stamens ∞, either all fertile with erect linear anthers dehiscing by terminal pores or short clefts; or the outermost sterile very short; filaments all slightly unequal, or the 5 innermost much the longest, spreading recurved. Carpels 5–∞ (of *Dillenia*), cohering only on the inside, ∞-ovulate; when ripe dehiscing internally or indehiscent; styles as many, free spreading. Seeds arillate.—Trees or shrubs; leaves broad, of parallel pennivenation; petioles dilated, wings deciduous; flowers large, solitary, or more frequently grouped in often unilateral terminal spurious racemes (*tropical Asia, Oceania, Madagascar*). See p. 108.

13. **Actinidia** Lindl.—Flowers hermaphrodite or polygamous, 5-merous. Sepals imbricated, persistent. Petals imbricated or contorted. Stamens ∞; filaments free; anthers introrse, finally versa-

tile, 2-celled dehiscing longitudinally; cells parallel on a linear more or less apiculate connective. Carpels ∞ united into a ∞-celled ovary; cells sometimes scarcely reaching the axis in the centre, free in that part; styles as many, diverging stellately at the base, or sometimes thickening on the nearly distinct apices of the carpels. Ovules ∞, subtransverse inserted in 2 rows in the internal angle of each cell. Fruit baccate ∞-celled; seeds ∞, imbedded in pulp; albumen copious; embryo straight, central, with an elongated cylindrical radicle; cotyledons short.—Shrubs often twining; leaves penniveined; flowers axillary, solitary or few, or often numerous in corymbose cymes (*tropical and subtropical Asia*). See p. 110.

III. MAGNOLIACEÆ.

I. MAGNOLIA SERIES.

AMONG the species of the genus *Magnolia*,[1] which has given

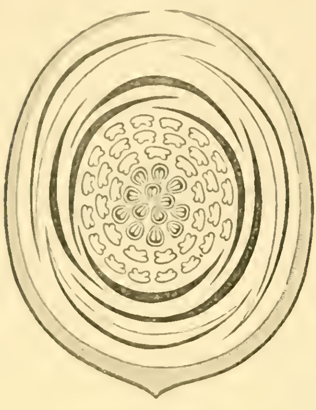
Magnolia grandiflora.
FIG. 165.
Flowering branch.

the name to this order, the best known are *M. grandiflora*[2]

[1] *Magnolia* L., *Gen.*, n. 690.—GÆRTN., *Fruct.*, i. 313, t. 70.—JUSS., *Gen.*, 281.—DC., *Syst. Veg.*, i. 449; *Prodr.*, i. 79.—ENDL., *Gen.*, n. 4737.—A. GRAY, *Gen. Ill.*, t. 23, 24.—WALP., *Rep.*, i. 70; *Ann.*, i. 956; iv. 41.—B. H., *Gen.*, 18, n. 4.—H. BN., *Adansonia*, vii. 3, 5, 66.

[2] L., *Spec.*, 755.—LAMK., *Ill.*, t. 490.—DC., *Prodr.*, i. 80, n. 1 (sect. *Magnoliastrum*); *Syst.*, i. 450.—MICHX., *Arbres Forest.*, iii. 71.—DUHAM., *Arbres*, ed. 2, ii. t. 65.—ANDR., *Bot. Rep.*, t. 518.—SIMS, *Bot. Mag.*, t. 1952.—SPACH, *Suit. à Buffon*, vii. 470 (sect. *Theorhodon*).

(figs. 165, 166, 168, 169), and *Yulan*[1] (figs. 167, 171) cultivated everywhere, of which the former has persistent leaves, the latter leaves which fall every year, and magnificent flowers produced at the end of the winter before the leaves. On examining these flowers we first notice that the axis or receptacle has the form of a cylindro-conoidal branch, bearing successively from below upwards a perianth, a large number of stamens, and carpels inserted on a spiral.[2] In the flower of *M. grandiflora* the perianth first presents three more or less greenish[3] free leaves, imbricated in the bud (fig. 166), so that most usually one is quite outside and one quite inside, while the third is overlapped by the former on one side, and overlaps the latter on the other. These leaves, usually described as sepals, fall early. Within are two corolline whorls, the one consisting of three petals alternate with the sepals, the other of three interior to these and alternate with



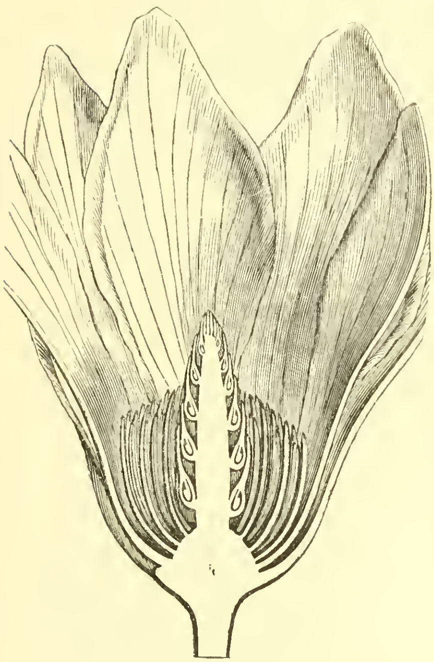
Magnolia grandiflora.
Fig. 166.
Diagram.

[1] Desf., *Arbres*, ii. 6.—DC., *Prodr.*, n. 10 (sect. *Gwillimia* Rottl.).—*M. conspicua* Salisb., *Par. Lond.*, t. 38.—*Yulania conspicua* Spach, *Suit. à Buffon*, vii. 464.

[2] The fraction of the phyllotaxy of the *Magnoliaceæ* is usually $\frac{2}{5}$. Accordingly, in the arrangement of the floral appendages we meet with the fractions derived from this up to $\frac{5}{13}$ and $\frac{8}{21}$.

[3] Their colour varies with the individual leaf and with the age of the flower. Very often the sepals when adult are as white as the petals, or nearly so. When young they are usually of a delicate green. These facts show how characters of coloration and consistency may be sometimes unreliable and insufficient to distinguish a calyx from a corolla. It would no doubt be more correct to say that in *M. grandiflora* L., the perianth is triple, and that the leaves of the two inner whorls are usually more *petaloid* when adult than those of the outer one. In other species the difference of coloration between the sepals and petals is no longer appreciable when adult. Thus, in many plants of *M. Yulan* Desf. and *Soulangiana* (hybrid), all the leaves of the perianth are so similar that one may well say that these flowers possess a triple corolla and no calyx. It is sometimes the same with the nine yellowish green primrose leaves of the perianth of *M. acuminata* L. In *M. glauca* L. they are sometimes all white and similar, sometimes the two or three outermost leaves are green. *M. macrophylla* Michx. has usually three green or greenish sepals and six white petals. In the flowers of *M. purpurea* Curt., we almost invariably find a great difference between the six petals, which are broad, erect, and wine-red on the outside, and the three sepals, which are small, and are early reflexed on the peduncle and become brownish. The total number of pieces in the perianth is also very variable in cultivated species; as many as twenty and upwards may sometimes be counted, as if the flower showed signs of becoming double. We have demonstrated (*Adansonia*, vii. 3) that these variations have no real importance; that in certain species those very leaves have been called sepals, which in others have been named petals; while the sepals of authors are often only bracts preceding the flower, representing the sheaths or dilated petioles of leaves, and continuing the spiral series of the leaves properly so-called. The sepals too are inserted along the same spiral. Hence it is that, as shown in fig. 166, there is no sepal exactly opposite or alternate with the bract which immediately surrounds the flower. Moreover, the nature of the pieces of the perianth is shown by these facts; they are leaves reduced to the basilar portion.

them. These six leaves are imbricated, or more rarely contorted in the bud, and also fall very shortly after the expansion of the flower. Above them commences the spiral of the pieces of the andro-



Magnolia Yulan.
FIG. 167.
Longitudinal section of flower.

Magnolia grandiflora.
FIG. 168.
Fruit.

ceum and gynæceum. The stamens are indefinite, each consisting of a subsessile anther, with an apiculate connective,[1]

[1] The stamens of *M. grandiflora* L., have a short filament quite continuous at its summit with the apiculate connective. The cells of the anther are distinctly introrse, the somewhat bulging back of the connective being left quite uncovered. Each cell is divided longitudinally into two smaller cells, very distinctly seen in a transverse section of the anther. The cells have nearly the same position in *M. glauca* L.; they are not seen at all on the back of the anther. In *M. macrophylla* MICHX. the anthers long remain sessile; it is only a few days before anthesis that we can distinguish the short flattened filament. The connective ends in a pyramidal point with three faces. The two cells occupy the inner face only, and in certain stamens nearly touch on the middle line; in others, a broader vertical strip separates them. The stamens of *M. Yulan* DESF. are unequal, the inferior being by far the shorter. Their anthers are less introrse than in the preceding species, as are those of *M. purpurea* CURT. (*Yulania Japonica* SPACH), where the cells are nearly marginal. Still they are inserted on planes bevelled off the inner surface, and are hence rather introrse than extrorse. This position of the cells does not appear sufficient to characterize a genus. The filament is thick and fleshy in *M. Yulan* DESF., and remains so for some time after the withering of the empty anthers. Nearly all the species have very caducous stamens. Cultivation often transforms a certain number of these into petals, then very evidently arranged in a spiral.

bearing on its inner face the two cells, adnate for their whole length, and each dehiscing by a longitudinal cleft.[1] The carpels, also indefinite, consist each of a one-celled ovary, surmounted by a horn-shaped style, bent outwards at the tip.[2] The whole of the inner face of the ovary and style is traversed by a longitudinal groove, of which the everted edges are covered above with numerous stigmatic papillæ. In the inner angle of the ovary is seen a parietal placenta bearing two descending anatropous ovules, with the micropyle looking upwards and outwards.[3] The fruit consists of a large number of finally dry carpels[4] inserted on the now woody axis. Each opens when ripe along the dorsal suture (fig. 168),[5] to free one or two seeds which remain for a variable time suspended to a slender filament (fig. 169).[6] Each seed has three coats;[7] the outermost is quite fleshy; the middle hard and testa-

Magnolia grandiflora.
FIG. 169.
Seed.

[1] The pollen of *M. grandiflora* L. consists of grains of the shape of a grain of corn, somewhat acute at each end, and with a large longitudinal fold due to the inflexion of the outer coat. H. MOHL has already pointed out that it has the same form as in most Monocotyledons (*Ann. Sc. Nat.*, sér. 2, iii. 221). In contact with water the form changes, so that the fold disappears, the length is diminished, and the ends are rounded. The exterior is covered with projecting granulations of a fatty consistency, and the superficial and deep parts of the grain present a marked contrast in colour. The centre is darkest, and finely granular. *M. macrophylla* MICHX., has similar pollen grains, but more elongated and fusiform.

[2] The style varies greatly in form and size from the short somewhat dilated horn of *M. grandiflora* L., or the slightly hooked subulate point of *M. Yulan* DESF., to the revolute and almost plumose style of *M. glauca* L., in which last the papillæ of the margins of the internal groove are not simple, but branched.

[3] When adult, they become more or less oblique, and sometimes even horizontal. At the same time, the micropyle inclines somewhat to the lateral walls of the cell, and the raphes approach one another on the middle line. They have two coats. There are sometimes three ovules in the ovary of *M. Yulan* DESF. and *macrophylla* MICHX.; the third is then superior and nearly median.

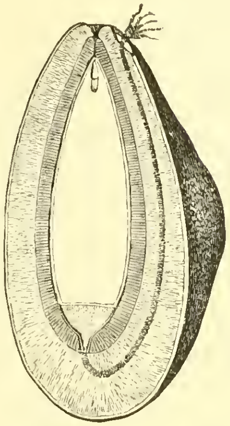
[4] In several species they long possess a fleshy consistency, and a pinkish or yellowish tint, recalling that of certain succulent pericarps. In some, the woody endocarp separates from the thicker and less consistent mesocarp after dehiscence.

[5] Dehiscence in most species takes place simply by a longitudinal cleft, of which the borders separate to form two lateral panels. In some others, as *M. macrophylla* MICHX., besides the two panels, we perceive the dorsal rib, woody, and like a long subulate filament, only attached to the receptacle by its base, and free from all adhesion to the lateral walls.

[6] This filament consists of tracheæ, which are continued into the raphe of the seed; the turns of their spirals separate as the seed descends.

[7] The curious organization of these seeds, with an outer fleshy coat, which LINNÆUS called an aril, has been a source of long discussions to the botanists of our times (MIERS, *Contrib.*, i. 162, 174, 211; HOOKER F. & THOMS., *Fl. Ind.*, i. 77; A. GRAY, in *Hook. Journ.*, vii. 243). The origin of the outer coat has been attributed to various organs, some making it a special sac emanating from the placenta, and finally enveloping the whole seed; while others consider it one of the proper seed coats, singularly modified after a certain age. This last interpretation alone appears satisfactory to us, as will be seen in the following extract from the special article we recently devoted to this subject (*Comptes Rendus*, lxvi. 700; *Adansonia*, viii. 159)—"The so much disputed origin of the fleshy coat of the seed of *Magnolia* is demonstrated both by its development and by its histological structure. It is formed by the hypertrophied cells of the primine, rich first in starch and afterwards in oily matter. Moreover, its thickness is traversed by the tracheal bundles of

ceous, the inner one membranous. This last is immediately surrounding the fleshy albumen, which contains a small dicoty-



Magnolia purpurea.
FIG. 170.
Longitudinal section of seed.

Magnolia Yulan.
FIG. 171.
Flower without its perianth.

ledonous embryo towards its apex (fig. 170). In the flower of *Magnolia Yulan*, of which it has been proposed to make a special genus under the name of *Yulania*,[1] the lower portion of the receptacle forms a dome-shaped swelling (figs. 167, 171), into the base of which is inserted the perianth. This, instead of consisting of six petaloid leaves, and three others, green like those of an ordinary calyx, usually presents nine leaves in three whorls, all similar,

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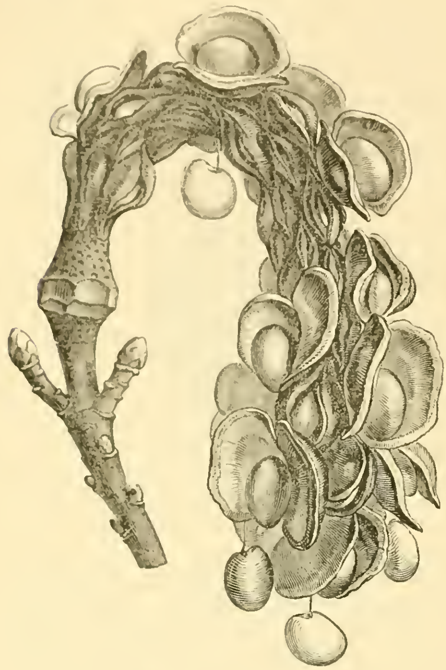
the raphe and its branches. As these vessels contain little but gas when mature, we have found a means of disclosing the path of the vascular network, by leaving the seed for some time in tincture of iodine. All the cells then become violet, and almost black, while the tracheæ remain only of a clear brown tint. We can now follow and dissect out all the tracheal network in the thickness of the parenchyma, much as we isolate the injected vessels of an animal. The bundle in the raphe, while giving forth branches on either side, proceeds to the chalaza, where it bends up to enter the interior of the seed. We must here describe a peculiar orifice in the testaceous middle coat, diametrically opposite the micropyle, and never encroached upon by the incrustations of the deep coat. The physiological importance of this new organ will be realized—a canal, of definite outline, which can be traversed by a very fine metallic style without any destruction of tissue, and which we call the '*heteropyle*.' The testaceous coat, which retains its primitive orthotropy, is thus furnished with two polar apertures. As to the superficial fleshy envelope, the older botanists termed it an *aril*, an appellation which recent authors have not adopted; and yet it forms a sort of *generalized* aril, far more worthy of the name than those partial hypertrophies of the outer seed coat to which it is now-a-days usually applied."

[1] SPACH, *Suit. à Buffon*, vii. 462. In this genus the author includes three species: 1° *Y. conspicua* (*Magnolia conspicua* SALISB.—*M. Yulan* DESF.); 2° *Y. japonica*, (*M. obovata* THG.;—*M. denudata* LAMK.;—*M. discolor* VENT.;—*M. purpurea* CURT.); of this *M. Soulangiana* SWEET and *liliiflora* LAMK., are considered simply forms; 3° *Y. Cobus* (*M. tomentosa* THG.; — *M. gracilis* SALISB.; — *M. Kobus* DC.).

of the consistency and colour usually presented by petals. Moreover, the fruit, instead of having all its elements close together in an ovoid mass, as in *M. grandiflora* (fig. 168) has a more elongated axis, more or less bent on itself (fig. 172), so that its carpels are further apart; some of these do not attain their full development.[1] It is however incontestible that on reviewing the fruits of all the *Magnolias* known, we find every possible transition between the form in *M. Yulan*, and that of *M. grandiflora*.[2] In many species, too, the number of pieces in the perianth is increased to a variable extent, either normally or through cultivation, while the form and colour of these parts vary greatly, without any value being assignable to these characters. But the flowers always terminate the branches, and there is no interval between the insertion of the stamens and that of the carpels on the receptacle.



Magnolia Yulan.
FIG. 172.
Fruit.

Not so in the small flowers of *Magnolia Figo*[3] (figs. 173, 174),

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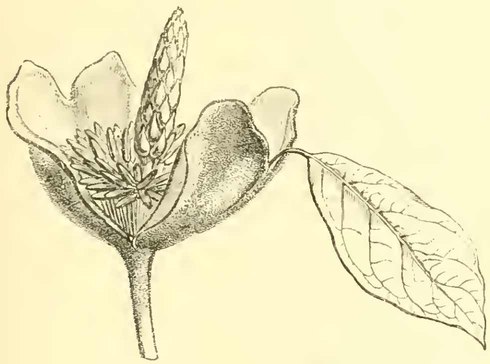
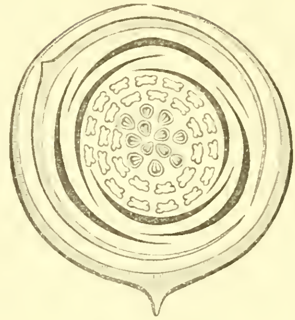
[1] The form and length of the receptacle in the ripe fruit are very variable. It is sometimes so short as only to bear one fertile carpel; at other times nearly straight, or slightly bent, or like a hook, as in fig. 172; or even bent twice on itself into an S, like the stock of a Bistort. In the fruits of this group, some carpels open along the whole length of the back, others only open halfway down; others, again, are partly detached from the receptacle along the inner angle, down which the cleft extends from the back. We find here, in fine, every possible transition between the dehiscence of *M. grandiflora* and that of *Talauma*, in which the carpels separate from the axis, and only open along a variable extent of the internal angle. It also happens, in certain species, that several neighbouring carpels are united laterally, and come off together in irregular flakes. This is very well shown in *T. fragrantissima*, in plates ccix., ccx. of HOOKER's *Icones*.

[2] Thus the fruit of *M. Campbellii* HOOK. F. & THOMS. (*Fl. Ind.*, i. 77), represented in the *Ill. Pl. Himal.* (t. 4), and reproduced in the *Flore des Serres* (t. 1282–1285), has also the conical fruit of *M. grandiflora*, but much elongated, and approaching the cylindrical form found in *Yulan* and the allied species, from which it further differs in being nearly straight.

[3] *M. fasciata* VENT., *Malmais.*, n. 24, not.—*M. fuscata* ANDR., *Bot. Rep.*, t. 229.—*Liriodendron Figo* LOUR., *Fl. Cochinch.*, ed. W., i. 424.—*Liriopsis fuscata* SPACH, *Suit. à Buffon*; vii. 461. — *Michelia* HANCE, *Ann. Sc. Nat.*, sér. 5, v. 205. We have elsewhere remarked

often cultivated in our conservatories. The receptacle is conical at its base, and then elongates into a column of which the lower part is contracted and bears no appendages; above this part the





Magnolia (Liriopsis) Figo.

FIG. 173. Flower, corolla removed.

FIG. 174. Diagram.[1]

carpels are inserted in a spiral as in other *Magnolias*, and also contain a placenta bearing two descending ovules in the internal angle of the ovary. On the lower part of the receptacle are seen the indefinite stamens with introrse anthers; and a little lower still the perianth, formed of six imbricated coloured similar leaves, in two trimerous whorls. We must no doubt consider these as petals.[2] Outside of, or rather below these, there are only two membranous leaves, which in the bud form two sacs fitting one within the other. Each represents the base of a leaf. We may regard it either as a sepal or a bract analogous to that which accompanies the flower of *M. grandiflora*. The flowers of *M. Figo* are usually solitary and axillary. However, when we cultivate them, it pretty often happens that the peduncle elongates and bears either several al-

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(*Adansonia*, vii. 7) that BENTHAM & HOOKER, while retaining *Michelia* as a distinct genus, yet consider (*Gen.*, 19) the *Liriopsis* of SPACH as referrible to the genus *Magnolia*, its characters being "*levioris momenti*" to entitle it to autonomy.

[1] In this diagram, the two appendages usually described as forming a calyx, are theoretically represented by the shaded curves outside. They are either two leaf sheaths, or two pairs of stipules united by the petiole; and it is one of these leaves, most usually reduced to the basilar portion, which, in fig. 173, is provided with an abnormal blade. The true perianth, which is a corolla, is represented by the black curves.

[2] The less petaloid, external leaves, usually considered as sepals, appear to be those which are wanting here. But this absence is of no great value, for they reappear in many *Michelias* with biovulate carpels, which are, moreover, quite inseparable from this plant in the rest of their organization. Usually the hairy bracts referred to above, and represented in fig. 173, are described as the calyx in *M. Figo*.

ternate bracts or leaves beneath the flower which terminates it. The inflorescence then becomes exactly that of *M. grandiflora.*[1]

Michelia,[2] considered by nearly all authors as a separate genus from *Magnolia,* has exactly the flower of *M. Figo,* and the receptacle also presents a naked interval between the stamens and the pistil. But in certain species the carpels, instead of always containing two ovules each,[3] contain a larger number[4] in two vertical rows. The fruit and inflorescence, too, are those of *M. Figo,* and hence we do not put all these plants in different genera. *Magnolia acuminata*[5] L. has flowers like those of the preceding species, but the colour of the petals is yellowish green, covered with a glaucous waxy bloom. There is no bare interval on the receptacle between the androceum and gynæceum, and each carpel is biovulate. The stamens, inserted on the conical portion of the floral axis, are unequal, with anthers rather longer and broader than the filaments; their two cells, which as in *M. Yulan,* approach the edges of the connective, are still introrse, as in all *Magnolias;* so that we also include in this genus *Tulipastrum,* of which *M. acuminata* is the type, and of which the characters are not sufficiently marked to justify its autonomy.

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[1] So that now this character cannot be called in as constituting a generic difference between *Magnolia* and *Michelia.* This fact we have already established (*Adansonia,* vii. 8). Moreover, HOOKER & THOMSON (*Fl. Ind.,* i. 79) admit a special section marked by terminal flowers for their *M. Cathcartii.*

[2] L., *Gen.,* n. 691.—GÆRTN., *Fruct.,* ii. 263, t. 137.—LAMK, *Dict.,* i. 190; *Ill.,* t. 493.—JUSS., *Gen.,* 280.—DC., *Syst.,* i. 447; *Prodr.,* i. 79.—BL., *Fl. Jav., Magnoliac.,* 6, t. 1–5.—SPACH, *Suit. à Buffon,* vii. 455.—ENDL., *Gen.,* n. 4739.—WALP., *Ann.,* iv. 38.—B. H., *Gen.,* 19, n. 6.—H. BN., *Adansonia,* vii. 66.—*Sampaca* RUMPH., *Herb. Amboin.,* ii. 199, t. 67, 68.—*Champaca* RHEEDE, *Hort. Malab.,* i. 31, t. 19.—ADANS., *Fam. Pl.,* ii. 365.

[3] The biovulate species sometimes present a third ovule, superior and median.

[4] *Magnolia punduana* WALL. (*Michelia punduana* HOOK. & THOMS.), has biovulate carpels, in which the ovules are at first placed back to back, and then one nearly above the other. With *M. oblonga* and *nilagirica,* it forms, for the authors of the *Flora Indica* (i. 81), a special section with axillary flowers and biovulate carpels, while *M. Champaca, excelsa, lanuginosa,* and *Kisopa,* represent another section, in which the ovaries contain either numerous ovules in two vertical rows, or only three ovules. In this last case, the carpels are those of the biovulate *Michelias,* which also accidentally present three ovules.

[5] *Spec.,* ed. 2, 756.—MICHX. F., *Arbr. Amer.,* iii. 82, t. 3.—DC., *Prodr.,* n. 5.—*Tulipastrum americanum, a, vulgare* SPACH, *Suit. à Buffon,* vii. 483. *M. cordata* MICHX., *Fl. Bor. Amer.,* i. 328, is referred by the same author to the Linnæan species, as var. β *subcordata.* The sepals are green, and of variable length, sometimes very short. The united carpels form an obovate mass. The styles are bowed, like horns, with two lips bearing stigmatic papillæ.

We also retain in the genus *Magnolia, Lirianthe grandiflora* SPACH, *Suit. à Buffon,* vii. 486 (*Liriodendron grandiflora* ROXB., *Fl. Ind.,* ii. 653.—*Magnolia pterocarpa* ROXB., *Pl. Coromand.,* iii. 266;—*Sphenocarpus* WALL., *Cat.,* 236), of which BENTHAM & HOOKER also say, "*characteribus levioris momenti a* Magnolia *separatur*" (*Gen.,* 19). The carpels, it is said, possess long terminal wings, owing to the expansion of the style; so that by its fruit this plant affords a transition between the *Magnolias* and the Tulip-trees.

The *Talaumas*[1] are *Magnolias*, in which the carpels, instead of dehiscing longitudinally along the back, separate by the base from the common axis of the fruit, or only open for a short extent above and internally, or else become woody and quite indehiscent, or fleshy and pulpy, only freeing the seeds by their putrefaction. This last condition is especially found in *Aromadendron*,[2] indigenous to Java. The *Buergerias*[3] which come from Japan have also a similar fruit; but the leaves of the perianth become more numerous, as also occurs sometimes in the true *Magnolias*. All these differences have seemed to us of little importance[4] and insufficient to warrant the removal of these plants from *Magnolia*, otherwise than as sections of the genus. If we analyse the magnificent flowers of *M. insignis* WALL.,[5] we see that they terminate the branches, as in *M. grandiflora*, and are constructed exactly the same way. But on opening the carpels we find in the internal angle from two to ten carpels and upwards. Hence in the fruit the carpels which dehisce dorsally often set free upwards of two seeds. This character is also found in four or five allied species, which have been collected into a special genus under the name of *Manglietia*,[6] but we do not retain this genus, for the same reasons which have led us to leave *Magnolia Figo* with biovulate cells, and *Michelia Champaca* whose carpels are multiovulate, in the same generic group.[7]

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[1] JUSS., *Gen.*, 281.—DC., *Syst.*, i. 460; *Prodr.*, i. 81.—BL., *Fl. Jav.*, xix. 29, t. 9–12.—SPACH, *Suit. à Buff.*, vii. 447.—ENDL., *Gen.*, n. 4735.—WALP., *Rep.*, i. 69; *Ann.*, iv. 41.—B. H., *Gen.*, 18, n. 3.—H. BN., *Adansonia*, vii. 669.—*Gwillimia* ROTTL., ex SPACH, *loc. cit.*—*Blumea* NEES, *Flora* (1825), 152.

[2] BL., *Bijdraj.*, 8; *Fl. Jav.*, xix. 25, t. 7, 8.—SPACH, *Suit. à Buffon*, vii. 451.—ENDL., *Gen.*, n. 4736. The calyx is here sometimes tetramerous, and the number of petals may be raised to thirty. The fruit is often characterized by its dehiscence: "*carpellis non nisi putredine ab axi secedentibus*" (B. H., *loc. cit.*). See p. 134, note 1.

[3] SIEB. & ZUCC., *Fl. Jap. Fam. Nat.*, i. 78, t. 2.—ENDL., *Gen.*, supp. v., n. 4736[1].—B. H., *Gen.*, 183.—MIQ., *Ann. Mus. Lugd. Bat.*, ii. 257.

[4] See *Adansonia*, vii. 6. When the carpels of a species like *M. Plumieri* (*Talauma Plumieri* SW.) separate in masses from the common axis, we see each carpel opens more or less widely into two lateral halves, beginning at the internal angle. The same fact occurs, as observed by us (*loc. cit.*), in *T. mutabilis*; we may also see it sometimes in the fruit of *M. liliifera* (*M. pumila* ANDR.; *M. Coco* DC., *Syst. Veg.*, i. 459; HANCE, *Ann. Sc. Nat.*, sér. 5, v. 205;—*Liriodendron liliifera* L.;—*L. Coco* LOUR., *Fl. Cochinch.* 1790), 347; *Gwillimia indica* ROTTL.;—*Talauma pumila* BL., *Fl. Jav.*, *loc. cit.*, t. 12, C.). We know that the *Magnolias* strictly so-called of the section *Yulan* present nearly all these variations in the way some of their carpels dehisce, though in these the dorsal cleft is usually more marked. But we cannot see generic distinctions in all this.

[5] *Tentam. Fl. Nepal.*, t. 1; *Plant. Asiat. Rarior.*, ii. t. 182.

[6] BLUME, *Bijdraj.*, 8; *Fl. Jav.*, xiv. 20, t. 6.—ENDL., *Gen.*, n. 4738.—HOOK. F. & THOMS., *Fl. Ind.*, i. 76.—MIQ., *Fl. Ind.-Bat.*, i. p. post., 15.—B. H., *Gen.*, 19, n. 5.—WALP., *Ann.*, iv. 40.

[7] See *Adansonia*, vii. 5, where we formulate our conclusion thus:—"The *Manglietias* are to the *Magnolias* as the multiovulate *Michelias* are to the biovulate *Michelias*."

Thus constituted,[1] the genus *Magnolia* contains half a hundred species, which are trees or shrubs, usually as remarkable for the beauty of their foliage as for that of their flowers, which are white, red, or greenish, and almost always scented. The leaves are alternate, persistent or deciduous, with the sides of the petiole dilated near the base into a sort of membranous sac, which according to most authors, represents the stipules, and which envelopes all the parts of the branch superior to it when young. If, for example, we examine the top of a branch of *M. grandiflora*, above the last developed leaf we see a membranous sac like an elongated cone inserted by its base all round the axis above the petiole. This sac certainly represents two lateral, somewhat supra-axillary stipules, for on the side next the petiole they become entirely separate from one another. Later on, the sort of leaf-opposed gutter thus formed again splits on the opposite side of the branch into two halves. These two organs then become detached at the base from the branch also, discovering the young parts at its summit, which were at first enveloped by these membranous caducous stipules. In this species they are free from the petiole. More frequently they adhere to it for one third, one half, or as much as at least two-thirds of its height. For their fall it is necessary that they should be detached from the petiole itself, and in this case we find on its inner face a scar like a narrow elongated hollow, indicating where they adhered to it.[2] The flowers are solitary, usually

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[1] *Magnolia.* Sections 5.
1. *Eumagnolia* (incl. *Yulania, Lirianthe, Tulipastrum*).
2. *Talauma* (incl. *Blumea, Buergeria, Aromadendron*).
3. *Manglietia.*
4. *Liriopsis* (incl. *Micheliopsis* H. Bn.).
5. *Michelia.*

A summary of the distinctive characters of these five sections, as established above, will be found in *Adansonia*, vii. 66.

[2] The chief arrangements affected by the stipule of *Magnolia* have been studied by Trécul in his "*Mémoire sur la formation des feuilles*" (*Ann. Sc. Nat.*, sér. 3, xx. 235). This savant observes that "in *M. Umbrella, Soulangiana,* &c., the stipules are united to one another and partly to the petiole. This union gives rise to a noteworthy phenomenon. The stipules persisting longer than the leaf, the blade falls off above the part united to the stipules, while this part only falls later with them. In *M. grandiflora* the stipules are free from the petiole and from one another." In the same work (296, figs. 175, 176) we find that the stipules of *M. grandiflora* have been studied in their development; a phenomenon described as follows:—"A protuberance arises on the summit of the axis, swollen at the base on the inner side. If we examine it in front, we see that the slender superior part and the swollen base are marked by a longitudinal groove which foreshadows the formation of the blade above and the stipules below. These I have always seen with their margins close together from their origin, concealing the summit of the axis. Here I speak of *M. grandiflora* only. The same thing occurs in *Liriodendron Tulipifera.*" We further read in a note: "The vernation is induplicative in *Liriodendron* and *Magnolia;* the leaf is folded along the midrib. In *M. grandiflora* there are often hairs at the top of the leaf before any have yet appeared at the base, to which they gradually extend along the midrib." In nearly all of the *Magnolias* there are mem-

terminal. We have seen, however, that in most of the species of the group comprising *Michelia* and *Liriopsis* the axillary branch bearing the flower is very short, and does not usually bear well-developed leaves beneath it. *Magnolias* are only found in the tropical regions of Asia,[1] Oceania,[2] and America;[3] and in the north of India,[4] in China,[5] Japan,[6] Mexico, the Antilles,[7] and the United States.[8]

The Tulip-trees (*Liriodendron*[9]) are closely analogous to the *Magnolias*, from which they are chiefly distinguished by two characters: the aspect of the anthers in the flower (figs. 175, 176); and the conversion of the carpels in the fruit into samaras which fall from the common axis when ripe (figs. 177, 178). The receptacle is of cylindro-conoidal form, bearing successively from below upwards, a calyx of three imbricated sepals; a double corolla with three imbricated petals in each whorl, the outer ones alternate with the sepals, the inner superposed to them; a large number of stamens and then of carpels, inserted in one continuous spiral. The stamens consist each of a free filament, and a two-celled distinctly extrorse anther, dehiscing longitudinally.[10] The carpels are free, consisting each of a unilocular ovary and a style, whose dilated summit is covered with stigmatic papillæ. In the internal angle of the ovaries may be seen two pendulous ovules, analogous to those of

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branous spathelike scales at the base of the leaf-bud, replacing the leaves. On the middle line we perceive a vertical projecting rib rising to a variable height on the scale, and then terminating in a minute apiculus or scarcely visible scar. This rib represents the petiole, and the apiculus is a rudimentary blade. We must remark that the petiole here usually falls with the stipuliform appendages, which do not separate from it as in the adult leaves. These scales, consisting altogether of the lower part of the leaf, afford a good explanation of the envelopes which have been called sepals. We shall again meet with a precisely similar organization in the Tulip-tree.

[1] ROXB., *Fl. Ind.*, ii. 653–655.—WIGHT & ARN., *Prodr. Fl. Pen. Ind.*, i. 6.—HOOK. & THOMS., *Fl. Ind.*, i. 74–82.—THWAIT., *Enum. Plant. Zeyl.*, 5.

[2] BL., *Bijdraj.*, 7–10; *Fl. Jav.*, *Magnoliac.*, 29–40, t. ix.–xii.—MIQUEL, *Fl. Ind.-Bat.*, i., pars 2, 13–16.—BLANCO, *Flor. Filip.*, 327.

[3] A. S. H., *Flor. Bras. Mer.*, i. 26, t. 4.—EICHL., MART. *Flor. Bras.*, *Magnoliac.*, 123, t. 28, 29.—HOOK., *Icon.*, t. ccviii–ccxii.

[4] HOOK. & THOMS., *op. cit.*, 74–82.

[5] THUNBG., *Flor. Jap.* (1784), 236.—BENTH., *Fl. Hongkong.*, 8.

[6] MIQ., *Ann. Mus. Lugd. Bat.*, ii. 257.

[7] SW., *Fl. Ind. Occid.*, ii. 997.—GRISEB., *Fl. Brit. W.-Ind.*, 8.

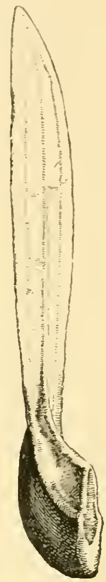
[8] MICHX., *Fl. Bor.-Amer.*, i. 327.—J. BROWNE, *Trees of Amer.*, 1.—A. GRAY, *Man. of Bot. North. Unit.-Stat.*, 15; *Gen. Ill.*, 59, t. 23, 23 *bis*.—CHAPMAN, *Fl. S. Unit.-Stat.*, 13.

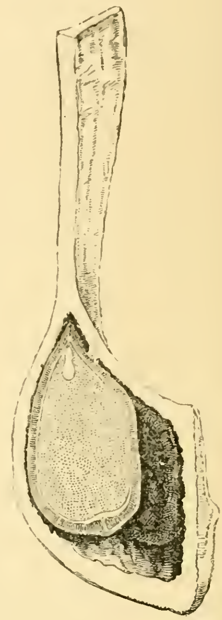
[9] L., *Gen.*, n. 689.—J., *Gen.*, 281.—LAMK, *Dict.*, viii. 137.—GÆRTNER, *Fruct.*, ii. 475, t. 158.—DC., *Prodr.*, i. 82.—SPACH, *Suit. à Buff.*, vii. 486.—ENDL., *Gen.*, n. 4740.—A. GRAY, *Gen. Ill.*, 63, t. 25.—B. H., *Gen.*, 19, n. 7.—H. BN., *Adansonia*, vi. 66.—*Tulipifera* HERM., *Lugd.-Bat.*, 612, *ic.*—ADANS., *Fam. Pl.*, ii. 365.

[10] The filament is short, dilated into a long connective, which is naked on the inner surface and slightly concave outside. The anther cells are only seen from without, and often even touch one another on the inner edge. The tip of the anther is usually apiculate.

Magnolia.[1] The fruit consists of an indefinite number of achenes, which when ripe fall off the common axis, and are dispersed by

Fig. 175.
Flower.





Liriodendron Tulipifera.

Fig. 176. Flower opened.

Fig. 177. Fruit.

Fig. 178. Longitudinal section of fruit.

aid of the woody wing flattened from within outwards which surmounts them.[2] Each of these samaras contains one or two seeds, which are constructed like those of *Magnolia*, but whose outer coat is much thinner and membranous.[3] Of this genus but one species is known, *L. Tulipifera*,[4] a native of North America, of which several varieties are cultivated in Europe. It is a large tree, with alter-

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[1] The style is flattened like a lanceolate leaf; it is already a representation of the wing which later on surmounts the fruit on a small scale. The dilated stigmatiferous tip is but little bifid. The ovules have two coats, and are suspended by narrow funicles. The raphe is internal, but at the same time the ovules are more or less back to back, as in *Magnolia*.

[2] The wing is formed by the persistent compressed style, which resembles a dry hardened leaf. The basilar part is provided with a vertical crest projecting slightly on both surfaces. Down the centre of these crests is a line, but little visible, along which we can determine the artificial separation of the fruit into two lateral halves by using a thin blade.

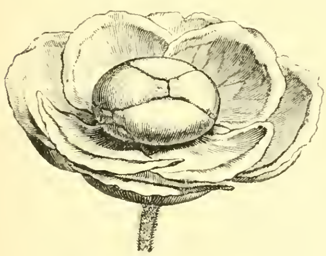
[3] The raphe passes through the thickness of this outer coat, which is not swollen and succulent as in *Magnolia*, but whose fundamental structure is just the same. The albumen is fleshy, and the small embryo it contains towards its apex is somewhat constricted at the junction of the radicle and the cotyledons.

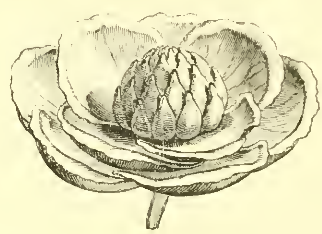
[4] Trew, *Icon. Select.*, t. 10.—L., *Spec.*, 755.—Lamk., *Dict.*, *loc. cit.*; *Illustr.*, t. 491.—Duham., *Arbr.*, éd. 2, iii., t. 18.—Michx., *Arbr.*

nate, petiolate leaves, whose blade is lyre-shaped, truncated at the apex,[1] and divided on each side into four more or less marked lobes. At the base of the petiole we observe two lateral stipules inserted a little above it, and which, when the leaf is young, cohere by their margins so as to form a completely closed sac, in which is enveloped all the young branch above this leaf itself. At this age the petiole is bent down at its middle, and the blade has its apex towards the axil, and the superior surface turned outwards. The flowers are solitary and terminate the branches, surrounded in the bud by bracts continuous with the series of leaves borne by the branch.[2] The Tulip-trees may on the whole be defined as *Magnolias* with extrorse anthers, and samaroid carpels which separate from the common receptacle.

II. SCHIZANDRA SERIES.

MICHAUX was the first to make known in Europe a North





Schizandra coccinea.

FIG. 179. Male flower.

FIG. 180. Female flower.

American liana with regular monœcious flowers (figs. 179–181),

iii. 202.—DC., *Prodr.*, i. 82.—SPACH, *op. cit.*, 488.—DE CUBIÈRES, *Mém. sur le Tulipier* (1803).—SIMS, *Bot. Mag.*, t. 275.

[1] This summit presents a small apiculus, which is merely the end of the midrib, produced here beyond the parenchyma. GODRON (*Observations sur les Bourgeons et sur les Feuilles du* L. Tulipifera, *Bull. Soc. Bot. de Fr.*, viii. 33, t. 1) attributes the truncation of the apex of the blade to the compression it undergoes during vernation while "retained in a groove formed by the base of one of the stipules and the axis." Already, in 1815, MIRBEL had given, in his *Eléments de Physiologie Végétale et de Botanique*, a very exact figure of the præfoliation of the Tulip-tree (t. 20). TRÉCUL (*Ann. Sc. Nat.*, sér. 3, xx. 296) has always seen the stipules joined together, howsoever young be the leaves, which are folded along the midrib, and arise before the stipules themselves. This botanist has also described and represented (t. 21, figs. 45–52) all the phases of the development of the leaves and their stipules.

[2] If we examine the position of the sepals relative to the five leaves below it on the branch, the uppermost of these being, indeed, the bract inserted immediately below the calyx, we see that these five are quincuncially imbricated, and that sepals 1, 2, and 3 are directly above leaves 1, 2, and 3 respectively. This relation shows how it is that here, as in certain *Magnolias*, there is no sepal exactly opposite the bract below the flower. The nature of the bract is not doubtful. It pre-

under the name of *Schizandra*.[1] The male flower (fig. 179) bears a perianth of about nine unequal imbricated leaves on the convex receptacle, which often appear to form trimerous verticils,[2] but present no distinction of calyx and corolla. The stamens, few in number (usually from four to six), are inserted in a spiral. The filaments are short and thick, assuming the form of a broad fleshy scale, triangular, but with the angles rounded off.

Schizandra coccinea.
FIG. 181.
Longitudinal section of female flower.

One of these angles is inferior, and gives insertion to the stamen; the two others, superior, bear the two widely-separated anther-cells. These cells dehisce by longitudinal clefts,[3] and are introrse, being almost entirely applied to the inner face of the triangular filament, so that in their normal position only a small part of their summit is seen. In the female flower (figs. 180, 181), the perianth and receptacle are as in the male flower, and the gynæceum consists of a large number of free carpels, inserted spirally on the somewhat swollen head of the receptacle, and crowded into a globular head. Each of these consists of a unilocular ovary, tapering above into a style scarcely dilated at the tip.[4] Externally corresponding to the ventral angle of the ovary, is a projection or crest, varying in size according to the

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sents a marked emargination at the summit, at the bottom of which is a small subulate process—the sole remnant of the summit of the petiole and blade. This bract then is wholly formed by the stipules which do not separate from the petiole. The sepals are probably of the same nature.

[1] *Flor. Bor.-Amer.*, ii. 218, t. 47 (1803).—HOOK., *Bot. Mag.*, t. 1413.—DC., *Prodr.*, i. 104.—ENDL., *Gen.*, n. 4733.—B. H., *Gen.*, 19, n. 8.—A. GRAY, *Mem. Amer. Acad.*, vi. 380; *Gen.*, 57.—H. BN., *Adansonia*, iii. 42; vii. 10, 66.

[2] There are from seven to ten leaves, but it is a mistake to consider that they are arranged in ternary whorls. With nine leaves it often so happens that the three innermost are opposite to, and the three middle ones alternate with, the three outermost. But often, again, this superposition and alternation are not exact. We have here to do with one continuous spiral.

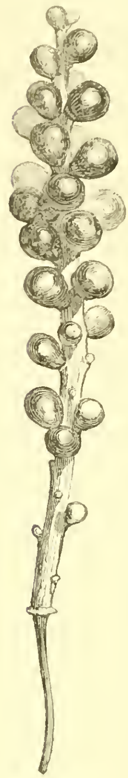
[3] These clefts often appear transverse or oblique owing to the direction of the anther cell, but are really longitudinal. If we follow out the development of the androceum in *S. japonica*, we see that the two cells are at first nearer the vertical and closer together. It is only by degrees that the connective and the top of the filament are simultaneously thickened to assume the form of a fleshy wedge separating the anther cells from one another. The pollen is nearly similar in *S. propinqua* and *japonica*. The grains appear discoidal at first sight, at least when dry; for moisture renders them spheroidal. The disc is much depressed in the centre on both faces, and the edge presents six notches alternately shallow and deep. The three latter notches correspond with the ends of as many clear bands radiating from the central depression, while the other three indicate the points where the pollen tubes protrude. The analogy of this pollen with that of *Drimys* inclines us to admit that we have here to do with an aggregation of three elementary pollen grains. (See *Comptes Rendus de l'Acad. des Sc.*, lxvi. 700; *Adansonia*, viii. 157.)

[4] See figs. 180, 181. In *S. japonica*, on the contrary, the summit of the short style is some-

species;[1] while inside is a placenta supporting two descending anatropous ovules, with the micropyle upwards and outwards.[2] The fruit consists of a large number of berries, which, instead of remaining close together as the carpels were in the flower, are echelonned on the floral axis (which is drawn out into a cylindroidal branch as represented in fig. 182), and each contains two pendulous seeds, within the coats of which is the curved, copious, fleshy albumen, with a small inverted dicotyledonous embryo towards its apex (fig. 190).

S. coccinea Michx.,[3] the only American species as yet known, is a sarmentose shrub, with alternate petiolate exstipulate simple leaves, and solitary pedunculate flowers[4] which arise from the axils of the first leaves or bracts of the young branches of the year's growth.

There are half a dozen species of the same group belonging to the Old World, which have been referred to the genera *Sphærostema*,[5] and *Maximovitzia*.[6] They only differ from the American plants in the rather variable number of their perianth leaves, and in the form and number of pieces in the androceum. Thus, in the flowers of *S. elongata*,[7] the stamens are far more numerous than in *S. coccinea*, and form more turns of the spiral, while they are more elongated into wedges, and taper more markedly at the base. But the fruit always presents the remarkable character of the elongation of its axis after fecundation (fig. 182). In the flowers of



Schizandra (Sphærostema) elongata.
Fig. 182.
Multiple fruit.

what everted, and covered with numerous soft stigmatic papillæ composed of almost confluent cells.

[1] The study of organogeny will alone reveal the origin of this projection. It is due to the decurrence of the base of the style, which is much compressed on this level by the two carpels interior to it, and gradually advances in the sort of angular space between them, and is, so to say, moulded on the concavity of this angle. The tissue thus deformed long remains soft and pulpy like the stigmatic papillæ. In *S. chinensis* this projection is continued a good way along the style itself in the flower; the borders are crenulate, and the whole forms like a crest capping the carpel.

[2] They are exactly collateral at first, but at a certain age undergo a slight torsion so as to bring the raphes closer together, and turn the micropyles towards the sides of the cell.

[3] *Op. cit.*, 219, t. 47.—DC., *Prodr.*, i. 104.—Sims, *Bot. Mag.*, t. 1413.—Torr. & Gray, *Fl. N.-Amer.*, i. 46, 662.—A. Gray, *Gen.*, t. 22.—Chapm., *Fl. S. Unit.-St.*, 13.

[4] The peduncle is slightly swollen towards the upper part, where it presents a transverse articulation.

[5] Blume, *Bijdraj.*, 22; *Fl. Jav.*, *Schizandr.*, xiii. t. 3–5; *Ann. Sc. Nat.*, sér. 2, ii. 91.—Juss., *Ann. Mus.*, xvi. 340.—Endl., *Gen.*, n. 4732.—Griff., *Icon. Posth.*, 651.—Hook. & Thoms., *Fl. Ind.*, i. 84.—H. Bn., *Adansonia*, iii. 43; vii. 11, 66.—Walp., *Rep.*, i. 92; v. 15; *Ann.*, iv. 79.—*Kadsura* Wall., *Fl. Nepal.*, i. t. 9–13.

[6] Rupr., *Primit. Fl. Amur.*, 31, t. 1.

[7] *Sphærostema elongatum* Bl., *Fl. Jav. Schi-*

S. chinensis,[1] the filaments of the stamens become yet more slender, and are not so closely packed; they have now the form of erect, somewhat flattened, rods, with narrow elongated anther-cells applied vertically along the borders of the connective, and looking outwards or inwards according to the stamen we observe. In *S. propinqua*,[2] the filaments become very short, while their tissue is thickened and swells with the receptacle, so that the androceum is only represented by sessile anthers, with their introrse[3] cells close together, embedded in a sort of niche hollowed out of

Schizandra (*Sphærostema*) *propinqua*.

FIG. 184. Male flower.

FIG. 183. Floriferous branch.

the substance of the large, spherical, fleshy receptacle (fig. 184). In this species, as in several others, the flowers are diœcious and solitary in the axils of the leaves of the adult branches (fig. 183).

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zandr., 17, t. v.; HOOK. & THOMS., *Fl. Ind.*, i. 85.—*S. grandiflorum* WALL., ex part.

[1] *S. japonica* A. GRAY, in *Mem. Amer. Acad.*, vi. 380.—MIQ., *Ann. Mus. Lugd.-Bat.*, iii. 91.—*Sphærostema japonicum* SIEB. & ZUCC., *Abh. Akad. Munch.*, iv. p. ii. 188.—*Maximovitzia chinensis* RUPR., *op. cit.* As we include in this genus *Kadsura japonica*, whose specific name must be retained according to the law of priority, we must modify that of the species under consideration and call it *S. chinensis*.

[2] *Sphærostema proquinquum* BL., *op. cit.*, 14.—HOOK. & THOMS., *op. cit.*, i. 85.—*S. pyrifolium* BL., *op. cit.*, 16, t. 4.—HOOK., in *Bot. Mag.*, t. 4614.—*Kadsura propinqua* WALL., *Tent. Fl. Nepal.*, 11, t. 15.

[3] The stamens are distinct when young. Later on the filaments are thickened with the receptacle into a sphere which connects all the anthers. But next to these the tissue of the former organs cannot assume that development, so that a certain number of pits are formed facing the introrse anther.

In short, the configuration of the androecum is very variable, and presents so many gradual changes in this genus as to render it impossible to found any exact subdivisions on it.

It is exactly the same with *Kadsura*,[1] a genus of plants from the South and East of Asia, which have been separated from *Schizandra* on account of a single absolute character—the form of the carpels as a whole. They are here united into a ball or short head, while those of *Schizandra* proper, form a sort of more or less elongated spike. But we are unwilling for this one reason alone to separate

Schizandra (*Kadsura*) *japonica*.[2]

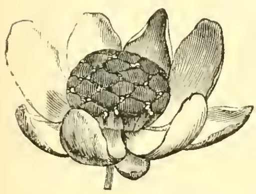

FIG. 185.
Male flower.

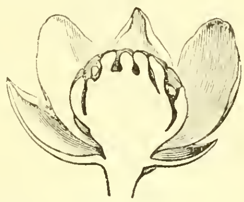

FIG. 186.
Longitudinal section of male flower.

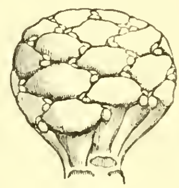

FIG. 187.
Androecum.

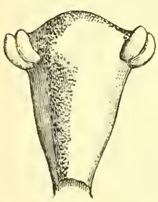

FIG. 188.
Stamen, isolated.

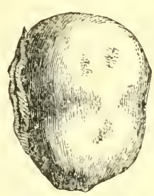

FIG. 189.
Carpel.

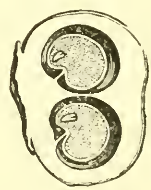

FIG. 190.
Longitudinal section of carpel.

Kadsura from *Schizandra*, except as a section,[3] because in *Magnolia*

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[1] KÆMPF., ex JUSS., in *Ann. Mus.*, xvi. 340.—DUNAL, *Mon. Anonac.*, 57.—DC., *Prodr.*, i. 83.—WALL., *Flor. Nepal.*, i. 7.—BL., *Fl. Jav.*, *Schizandr.*, 7, t. 1, 2.—SIEB. & ZUCC., *Fl. Japon.*, i. 40, t. 17.—ENDL., *Gen.*, n. 4731.—BENTH., *Fl. Honkg.*, 8.—HOOK. & THOMS., *Fl. Ind.*, i. 83.—H. BN., *Adansonia*, iii. 43; vii. 11, 66.—B. H., *Gen.*, 19, n. 9.—MIQ., *Fl. Ind.-Bat.*, i., pars 2, 18.—WALP., *Rep.*, i. 92; v. 15; *Ann.*, iv. 78.—*Sarcocarpon* KÆMPF., *Amœn. Exot.*, 476, 185, t. 477.—BL., *Bijdraj.*, 21. Although LINNÆUS admitted *K. japonica*, it was A. L. DE JUSSIEU, who in 1810 (*Ann. Mus.*, xvi. 340) considered the *Uvaria japonica* of THUNBERG worthy of forming a special group. Of this plant, he says, "we propose to make a separate genus under the name of *Kadsura*." Hence, in uniting *Kadsura* and *Schizandra* into one genus, we have had to prefer the latter name, which dates from 1803, and which we find possesses the further advantage of not forcing us to suppress the name of *Schizandreæ* in order to substitute that of *Kadsureæ*.

[2] *Schizandra japonica* H. BN. (nec A. GRAY).—*Kadsura japonica* L., *Spec.*, 756.—DUN., *Mon. Anonac.*, 57.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 91.—DC., *Prodr.*, i. 83.—*Uvaria japonica* THUNB., *Flor. Japon.*, 237.—*Futa Kadsura*, &c., KÆMPF., *loc. cit.*

[3] See *Adansonia*, vii. 10. Especially is it impossible to distinguish *Kadsura* and *Schizandra* by the aspect of the anthers, and authors (such as ENDLICHER) are wrong in attributing extrorse

the receptacle of the fruit also varies greatly in form, being sometimes ovoid or nearly globular, and sometimes long, cylindrical, and branch-like, without making it in the least possible on that account to parcel out the genus. The stamens are sometimes shaped like fleshy wedges (figs. 187, 188), at others like narrow rods, more or less free. Some of them may be reduced to staminodes of very unequal size.[1] Thus understood, the genus *Schizandra* includes half a score species, and by itself constitutes the series of *Schizandreæ*, which may be defined as follows: *Magnoliaceæ* with unisexual flowers, the perianth always imbricated, and the leaves always exstipulate.

III. ILLICIUM SERIES.

The Aniseed-trees (*Illicium*,[2] Fr. *Badianier*) have regular, hermaphrodite flowers. On the slightly convex receptacle are successively inserted a perianth, androceum, and gynæceum, of free elements, varying considerably in number, form, and colour, according to the species. If we examine, for example, the flower of *I. parviflorum*[3] (figs. 191–194), an American species much cultivated in our conservatories, we find that the perianth consists of about fifteen dissimilar leaves inserted on a spiral, the outer ones shorter and more greenish, the inner ones on the contrary larger, thinner, petaloid, and of a pale yellow colour; but between them we find every transition in texture and tint, so that it is almost impossible to assign exact limits between calyx and corolla. All these parts

anthers to all the species of both genera, for in both *S. propinqua* and *K. japonica* they are certainly introrse.

[1] This fact is very marked in a species which has been for some years cultivated in our conservatories under the name of *Cosbœa Coccinea* (see *Adansonia*, iii. 4), and which is *Kadsura chinensis* HANCE (*K. japonica* BENTH., *Fl. Hongkong.*, 8, nec DUN.). The receptacle of the male flower is drawn out into a column, and bears stamens at some distance from each other like little erect rods. The uppermost are sterile and end in a point. The lower ones bear an anther with two oblique cells. The top of the column is bare, and recalls the extremity of the spadix in certain *Aroideæ*. We shall call this species *S. Hanceana*.

[2] L., *Gen.*, n. 611.—ADANS., *Fam. Pl.*, ii. 364.—JUSS., *Gen.*, 280.—LAMK., *Dict.*, i. 351.—DC., *Syst.*, i. 440; *Prodr.*, i. 77.—SPACH, *Suit. à Buff.*, vii. 439.—ENDL., *Gen.*, n. 4743.—MIERS, *Contrib.*, i. 142.—B. H., *Gen.*, 18, n. 2.—H. BN., *Adansonia*, vii. 8, 67, 361; viii. 1.—*Badianifera* L., *Mat. Med.*, 510.

[3] MICHX., *Flor. Bor.-Amer.*, i. 326. — VENT., *Hort. Cels.*, t. 22.—DC., *Prodr.*, i. 77, n. 3.—MIERS, *op. cit.*, 143, n. 5.—*Cymbostemon Parvifolius* SPACH, *op. cit.*, 446.

are imbricated in the bud, and fall early from the receptacle.[1] The stamens are also of variable number, usually from six to nine.

Illicium parviflorum.

FIG. 191.
Floriferous branch.

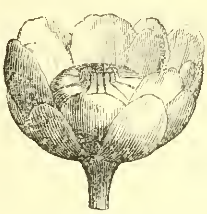

FIG. 192.
Flower.

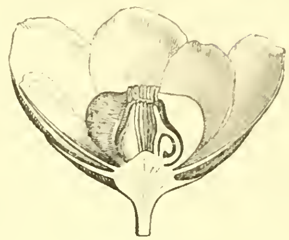

FIG. 193.
Longitudinal section of flower.

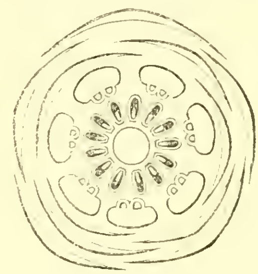

FIG. 194.
Diagram.

They appear arranged in a single verticil,[2] and each consists of a free, thick, fleshy, boat-shaped, obliquely obovate or club-shaped filament, and an introrse anther with two small parallel cells, applied vertically close together towards the summit of the inner face of the filament, and dehiscing longitudinally.[3] There are from ten to fifteen carpels also apparently arranged in a circle round the apex of the floral axis which projects in their centre,[4]

[1] Still, some of the outermost shorter and greener (calycinal) leaves persist rather longer than the inner ones and the stamens.

[2] The study of organogeny has taught us that they really arise in a spiral order, but very close to one another (*Adansonia*, vii. 361).

[3] The pollen consists of whitish grains, which become spherical when wetted. The poles of the sphere are connected by three equidistant meridional bands, down the centre of each of which is a little dark longitudinal streak. In the interspaces of these bands the surface of the sphere is punctate, and almost granular. The bands are pale and smooth. In an unmoistened pollen-grain the poles are much depressed and approximated. The form of the grain is, as it were, discoidal. The bands of which we have just spoken go from the depressed centre of the disk to the edges, where they end in three indentations, which separate as many projecting blunt festoons. By analogy with what is observed in *Drimys*, *Schizandra*, &c., we should here have to do with a compound pollen-grain made up of three simple ones. (See *Comptes Rendus*, lxvi. 700; *Adansonia*, viii. 157.)

[4] This apex of the receptacle projects far more

each consisting of a unilocular ovary tapering above into a style, whose apex is furnished with stigmatic papillæ.[1] Close to the base of the inner angle, the ovary presents a placenta bearing a single ascending anatropous ovule with its micropyle downwards and outwards.[2] The fruit is multiple, consisting of as many follicles as there were carpels in the flower, or nearly so. These are coria ceous, compressed, apiculate, and united into a star (fig. 197) round the common axis,[3] a fact which has given one of the species of the

Illicium anisatum.

Fig. 195.
Flower.

Fig. 197.
Fruit.

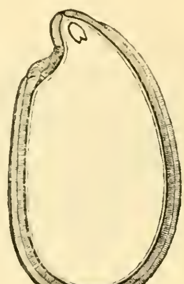

Fig. 199.
Longitudinal
section of seed.

Fig. 196.
Gynæceum.

Fig. 198.
Seed.

genus, *I. anisatum*, its vulgar name of *Star-anise* (Fr. *Anis etoilé*). They open along the inner angle, and each contains one seed. This encloses

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in proportion in the very young bud, extending even above the summit of the carpels as a thick cone with an obtuse summit.

[1] These papillæ are placed on both lips of a longitudinal groove, borne by the inner angle of the carpel. They descend low down on these lips, becoming gradually more scanty, and even reach the level of the ovary.

[2] It is incompletely anatropous, and possesses two coats. The secundine forms a sort of tubular neck above the nucleus, passing into the exostome, or even protruding through it.

[3] The fruit of *I. parviflorum* consists of about fifteen horizontal rays, each representing a follicle, of which the line of dehiscence is quite superior and horizontal. At the centre of the upper surface of the fruit, on a level with the point of union of all the carpels, is a circular depression, forming a sort of well, at the bottom of which rises a small apiculus, the remains of the organic apex of the receptacle. Scarcely visible on all the rest of the outer surface are slight rugosities, which become well marked on the Star-anise of Batavia. The apex of the follicle is acute, and but slightly turned up.

within its coats an abundant fleshy albumen, having towards its apex a small embryo with its radicle superior (figs. 198, 199[1]).

In another plant of this genus found in Japan, which has been called *I. religiosum*[2] (figs. 195–199), we observe certain tolerably well marked differences. The leaves of the perianth, about twenty in number, are all of the same colour, yellow or greenish white, and change insensibly in form and size as they ascend on the receptacle.[3] Above these are a score of stamens inserted on a spiral with very close turns.[4] The filaments are short and fleshy, but not gibbous as in *I. parviflorum*, and their anthers, far more elongated, have two adnate introrse cells,[5] above which the connective projects. The carpels, usually eight in number,[6] form a sort of crown, in the centre of which the apex of the receptacle projects. On this the ovaries are inserted very obliquely: each is surmounted by a horned style, and the whole of the internal angle of ovary and style is traversed by a vertical groove, whose lips are covered with stigmatic papillæ.[7] In each carpel is an erect, incompletely anatropous ovule.[8] The fruit of this species, which when very aromatic constitutes the *Star-anise* (*I. anisatum*) of commerce[9]

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[1] These figures refer to the Star-anise of commerce. MIERS also has given an analysis of the seeds in his *Contributions* (i. t. 27). The anatropy is not complete. The umbilicus is like a large depressed cicatrix, to the outside of which is a little micropylar beak with an obtuse tip. There are three seed coats. The outermost is smooth and shining. It tapers abruptly, and is, as it were, bevelled off at the base of the beak just described. The middle coat is thick and brownish. The innermost is whitish and membranous. At the base of the raphe is seen a brownish elliptical chalazal stain. The embryo is very minute compared to the enormous fleshy albumen, of which it occupies a small cavity near the micropyle. The turbinate mass of the embryo is supported by a slender suspensor. The cotyledons, but little marked, obtuse, and separated from one another, look directly upwards.

[2] SIEB. & ZUCC., *Fl. Japon.*, i. 5, t. 1.—SPACH, *op. cit.*, 440.—MIERS, *op. cit.*, 143, n. 2.—*Bot. Mag.*, t. 3965.—*I. anisatum* THG., *Fl. Japon.*, 235. This plant, together with *I. anisatum* L. (*Spec.*, 664), the section *Badiana* of SPACH. To us (*Adansonia*, viii. 1), as to MIQUEL (*Ann. Mus. Lugd. Bat.*, ii. 257), it is only another form of the *I. anisatum* of LINNÆUS.

[3] Hence there is no distinction of calyx and corolla. Here also we find every transition between the outer and the inner leaves.

[4] It often happens that there are transitions between the corolla and the pieces of the androceum. One or two of the outermost stamens may be half-petaloid.

[5] The cells are marginal, and at a variable distance from one another in the outer stamens. In the inner ones they come to touch by the inner edge.

[6] This number is by far the commonest. As it is very often found in the ripe fruit also, we see that the abortion of the carpels frequently spoken of does not occur. In this matter it is probable that some American species has been confounded with *I. anisatum*. There are often six or seven carpels in the gynæceum, all fertile; and sometimes nine or ten.

[7] These papillæ are less prominent and numerous as we approach the insertion of the carpels, but some are yet found on the ovary itself.

[8] The exostome is at some distance from the hilum, and completely surrounded by the primine giving passage to the sort of little truncated neck formed by the endostome.

[9] The only differences which can be established between the fruit of *I. anisatum* of commerce and that of *I. religiosum* are as follows:—1. The surface; the fruits of *I. religiosum* are often less rugose than in *I. anisatum*. 2. The form of the apex of the carpels; those of *I. religiosum* usually possess a more acute and somewhat curved beak. 3. The scent of the ripe fruit, which is a little less aromatic and more resinous in *I. anisatum*. We have

(fig. 197), usually consists of eight follicles. *I. Griffithii*,[1] which grows in India, is a species with very little aroma, closely analogous to the preceding in all its characters, but with more numerous carpels,[2] and the leaves of the perianth more dissimilar, the outer ones being far broader, thicker, and more rounded than the inner ones, whose consistency is that of petals.

Finally, *I. floridanum*,[3] which is cultivated in our conservatories, presents even more dissimilarity in its floral appendages. The outer ones are large and of a whitish green,[4] as sepals often are, while the middle ones, membranous and still broad, are of a very deep purple, as are also the inner leaves, which become much narrower and more elongated; so that we here find three kinds of leaves in the perianth. The stamens have a fleshy filament and a broader connective, flattened like a racket or battledore. The carpels are as numerous as in *I. Griffithii*, and the summit of the receptacle also projects in the centre of the flower.[5]

Leaving aside all these unimportant differences, all the members of the genus *Illicium*, whether from North America,[6] the Antilles,[7] India, China, or Japan,[8] present a very large number of characters

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to decide whether these differences, especially in cultivated plants, are sufficient to form two species; and, if the specific autonomy of *I. religiosum* is not very contestible, it is very strange that KÆMPFER (*Amœn. Exot.*, 880), whose minute exactitude is well known, having only the *Skimi* before his eyes, should have wrongly taken it to be the plant of China or Corea (*Koraï*), which produces the Star-anise of commerce. At any rate, SIEBOLD and ZUCCARINI (*Fl. Japon.*, i. 5, t. 1) thought he was wrong when they regarded as the only true *I. anisatum* the plant spoken of by LOUREIRO (*Fl. Cochinch.* (1790), 353) and GÆRTNER (FRUCT., i. 338, t. 69), and not the plant which DE CANDOLLE referred to the same species (*Prodr.*, i. 77, n. 2) after THUNBERG and many others. Hence they made of the *Skimi* a distinct species under the name of *I. religiosum*. However, we have seen no other species than theirs among all the specimens contained in the collections from Japan, and especially in those preserved in the Royal Herbarium of Leyden, and we shall retain *I. anisatum* and *religiosum* in one species. (See *Adansonia*, viii. 9.)

[1] HOOK. & THOMS., *Fl. Ind.*, i. 74.—MIERS, *Contrib.*, i. 143, n. 3.—WALP., *Ann.*, iv. 42. This species has about twenty-five leaves in its perianth.

[2] From fifteen to twenty may be counted. When mature they spread horizontally, and also dehisce by clefts with sharp edges. The apex elongates into a small apiculus, erect or slightly reflexed in the ripe fruit. They appear very slightly aromatic.

[3] ELLIS, in *Phil. Trans.*, lx. (1779), 524, t. 12.—LAMK., *Illustr.*, t. 493, fig. 1.—GÆRTN., *Fruct.*, i. 339.—BUCHOZ, *Pl. Nouv. Découv.* (1771), t. xxviii.—*Bot. Mag.*, t. 439.—SPACH, *op. cit.*, 443.—A. GRAY, *Gen. Ill.*, i. 56, t. 21.—MIERS, *loc. cit.*, n. 4. To SPACH this species constitutes the section *Euillicium*.

[4] These outer leaves are also the shortest and broadest. Within them are others of a purple colour; some broad, and the others, quite inside, narrow and acute. If we wished to make a distinction, we should have to admit three sorts of perianth in this flower. The stamens have a filament shorter than the anther, which is constructed like that of *I. anisatum*. There are from twelve to twenty carpels.

[5] This summit when adult is covered with fine papillæ, while in the other species of this genus it is glabrous.

[6] MICHX., *op. cit.*, i. 326.—A. GRAY, *Gen. Ill.*, 55.—CHAPM., *Fl. S. Unit.-Stat.*, 12.

[7] GRISEB., *Cat. Pl. Cub.*, 2.

[8] HOOK. & THOMS., *Fl. Ind.*, *loc. cit.*—SIEB. & ZUCC., *loc. cit.*—WALP., *Rep.*, i. 72; *Ann.*, iv. 42.

in common. All are shrubs or small trees, with persistent, alternate, petiolate, exstipulate, glabrous leaves, covered with pellucid dots, and more or less aromatic. The flowers are pedunculate and terminal in the American species with dilated filaments (*Cymbostemon*[1]), but buds, at first lateral with respect to them, and originally axillary to the leaves or bracts below them, may in time receive a great development and elongate into branches which push aside the peduncles, making them appear axillary. *I. anisatum* and the species analogous to it (*Euillicium*), on the contrary, have their flowers axillary from the commencement.[2]

When we know *Illicium*, it is very easy to obtain an exact idea

Drimys Winteri.
FIG. 200.
Floriferous branch.

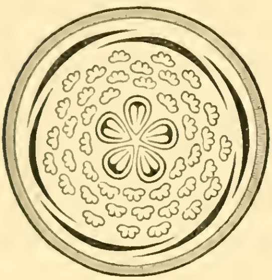
of the structure of *Drimys*,[3] which may be considered as *Illicium*,

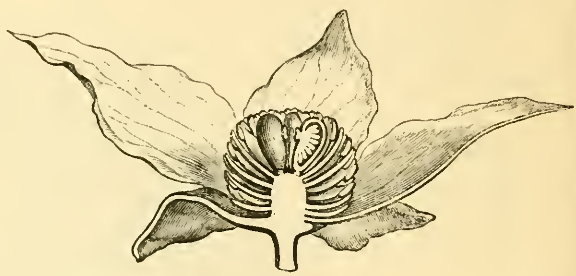
[1] See fig. 191 and *Adansonia*, vii. 361. The floral peduncle of *I. parviflorum* is the continuation of a branch; beneath the flower it bears one or several bracts, some echelonned on the peduncle, the others close together below the flower.

[2] See *Adansonia*, viii. 13. Hence, for these species alone can we admit what BENTHAM & HOOKER say (*loc. cit.*) of the inflorescence of *Illicium*: "*Pedunculi 1-flori, revera axillares, sed foliis non evolutis intra gemmam terminalem fasciculati.*"

[3] FORSTER, *Char. Gen.*, 84, t. 42.—JUSS., *Gen.*, 280, 451.—LAMK., *Dict.*, ii. 830; *Suppl.*, ii. 526; *Ill.*, t. 494.—DC. *Prodr.*, i. 78.—SPACH, *Suit. à Buffon*, vii. 436.—ENDL., *Gen.*, n. 4742.—MIERS, *Contrib.*, i. 132.—B. H., *Gen.*, 17, n. 1.—H. BN., *Adansonia*, vii. 8, 67.—*Winterana* SOL., *Med. Obs.*, v. 46.—*Wintera* MURR., *Syst.*, 507.—

with multiovulate carpels, and presenting, besides the perianth of numerous unequal imbricated leaves, a valvular membranous sac of a single piece considered by botanists as a calyx. At flowering time this sac is torn irregularly from above downwards into two, three, or four unequal caducous lobes. We then see the interior leaves, of very variable number, inserted in a spiral on a fairly elongated receptacle, the turns of which are more widely separated on a level with the androceum. This consists of a large number of unequal stamens. In the flowers of *D. Winteri*[1] (figs. 200–202), famous for producing the *Winter bark*, there are often more than fifty stamens, shorter as they are more inferior, and each consisting of a flattened filament and a two-celled extrorse anther, dehiscing longi-





Drimys Winteri.

FIG. 201. Diagram.

FIG. 202. Longitudinal section of flower.

tudinally.[2] The sessile carpels, about five in number,[3] free, and forming a crown around the summit of the receptacle, on which they are articulated, consist each of a unilocular ovary and a very

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H. B. K., *Nov. Gen. et Spec. Pl. Æquin.*, i., t. 58.—*Magallana* COMM.—*Canella* DOMB. (nec P. BR.).—*Boique* MOL. (ex. ENDL., *Enchr.*, 428). —*Tasmannia* R. BR., ex DC. *Syst. Veg.*, i. 445; *Prodr.*, *loc. cit.*, n. 4.

[1] FORST., *loc. cit.*—FEUILL., *Obs.*, iii. 10, t. 6.—*Bot. Mag.*, t. 4800.—MIERS, *op. cit.*, 135, n. 5.—EICHL., in MART. *Flor. Bras.*, *Magnoliac.*, 132, t. 30–32.—*D. punctata* LAMK., *Dict.*, ii. 330; *Ill.*, t. 494, fig. 1.—*D. aromatica* DESCOURT., *Fl. Ant.*, i. t. 40.—*D. polymorpha* SPACH, *op. cit.*, 437.—*Winterana aromatica* SOL., *loc. cit.*, t. 1.—*Wintera aromatica* MURR., *loc. cit.*; *App. Med.*, iv. 507.—W., *Spec. Plant.*, ii. 1239. This species is the type of the section *Wintera* (DC., *Syst.*, i. 443) thus characterized: "*Calyx* 2, 3-*partitus aut* 2, 3-*sepalus*."

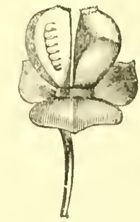
[2] The cells are sometimes close together all the way, and sometimes diverging towards the base. The pollen of *Drimys* has been described by H. MOHL (*Ann. Sc. Nat.*, sér. iii. 179) as formed of grains aggregated into fours; their relative places are those which they would occupy if placed at the vertices of a regular tetrahedron. In the pollen of *D. granatensis*, for many authors a variety of *D. Winteri*, we have seen a large depressed pit occupying the centre of each of these grains. On wetting the pollen the depression disappears, and in its place the walls of the cell form a dome-shaped projection recalling those seen at the angles of the pollen grain of certain *Onagrarieæ*. EICHLER has also recently figured the pollen of *D. Winteri* (*Flor. Bras.*, *Magnoliac.*, t. 30, fig. 12).

[3] There are rarely more in the typical species. In *D. granatensis* are as many as eight or ten. In several forms from South America we may find flowers with only three, two, or even one carpel, as in the species of the section *Tasmannia*.

short style covered with stigmatic papillæ, situated at a variable height on the inner angle of the ovary. Within, on this internal angle is seen a parietal placenta of two vertical lips, on which are borne the two rows of horizontal or slightly oblique anatropous ovules, placed back to back.[1] The fruit consists of several indehiscent many-seeded berries. Contained within the seed coats[2] is the fleshy albumen with the embryo near its apex.

D. Winteri is a shrub or small tree, with alternate exstipulate persistent leaves covered with pellucid dots, inhabiting the west of America from the south of Mexico to Cape Horn, always supposing that it is right to put every *Drimys* of this region into one species.[3] The flowers are axillary to the upper leaves of the branch, or the bracts which continue their series; they are solitary or united into false umbels,[4] of which the pedicels, varying in number, spring from one common axillary peduncle. Beyond the inflorescence (whose axillary situation is thus demonstrated) the branch elongates into a shoot which rarely aborts, more frequently grows very little longer, and bears leaves reduced to scales or bracts, or else becomes like ordinary branches, and bears leaves as well developed as those observed below the flowers. All the parts of this plant are very aromatic.

In one species from New Zealand, *D. axillaris* Forst.,[5] which De Candolle has made the type of his section *Eudrimys*,[6] the flowers are polygamous and often unisexual (figs. 203, 204); they present the very peculiar character of arising, not at the base of the young branches, but well on the wood of the older ones, usually axillary to the last year's leaves, and are borne on one-flowered pedicels, solitary or few in number.[7] The calyx, very short,



Drimys (*Eudrimys*) *axillaris*.

Fig. 203. Male flower.

Fig. 204. Longitudinal section of young fruit.

[1] There are usually ten, five in each row; some carpels contain as many as thirty. The inferior ones are descending; but towards the top of the ovary they are nearly horizontal, or even slightly ascending. They have two coats.

[2] The outer coat is smooth, crustaceous, and brittle. The seed is more or less recurved and reniform (see Eichler, *loc. cit.*, fig. 24).

[3] As J. Hooker proposes (*Fl. Antarct.*, i. 229).

[4] In *D. granaticum* L. Fil., *Suppl.*, 269), considered, as we have said, by several authors, a simple variety of *D. Winteri*, the study of the very young inflorescence has shown us that it is a bunch of cymes.

[5] *Gen.*, 84, t. 42.—DC., *Prodr.*, i. 78, n. 1.—Hook., *Icon.*, 576.—Hook. F., *Fl. N.-Zéland.*, 1, 12.—Miers, *Contrib.*, 132, n. 1.—*D. colorata* Raoul, *Ch. de Pl. N.-Zél.*, 24, t. 23 (figs. 203 and 204 are extracted from that work).

[6] *Syst. Veg.*, i. 442.—Miers (*loc. cit.*), "Div. 1. *Pedunculi plurimi, aggregati, axillares, 1-flori.*"

[7] They then form a cyme.

often dimerous or nearly entire, forms a sort of cupule at the base of the flower, which, even in a very young bud, does not surround the interior organs completely.

In another species from New Caledonia, which we have called *D. crassifolia*,[1] the calyx presents the same characters as in *D. axillaris;* but the flowers are grouped at the top of the branches into false compound umbels of cymes several times[2] ramified. The abortion of the terminal shoot seems constant in this species, which, in this respect, approaches certain forms of *D. Winteri.*

R. Brown has made a special genus, *Tasmannia*,[3] of some Australian and Tasmanian species of *Drimys*, with flowers often diclinous like

Drimys (*Tasmannia*) *lanceolata.*
Fig. 205.

those of *D. axillaris*, carpels few in number, and pericarp not very thick. In *T. aromatica*[4] (figs. 205–207), which has been rightly

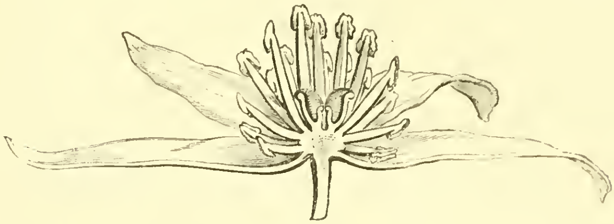
[1] *Adansonia*, viii. 190. This species has very large and thick leaves, first fleshy and afterwards coriaceous; the midrib is covered with minute pits. The calyx, very thick at its base, consists of two or three lobes with variable depth. The carpels, usually four in number, become thinner and wedge-shaped at the base. We make it the type of a section called *Sarcodrimys*.

[2] Each of the peduncles is ramified four or five times. The cymose arrangement is sometimes very manifest. A terminal flower on a very short axis is accompanied by two lateral pedicels, far longer and more slender, which arise nearly on a level, and belong to the flowers of the next generation.

[3] Ex DC., *Syst. Veg.*, i. 445; *Prodr.*, i. 78.—Endl., *Gen.*, n. 4741.—Miers, *Contrib.*, i. 138.

[4] R. Br., *Prodr. Nov.-Holl.* (ined.), ex DC., *loc. cit.*—*Winterania lanceolata* Poir., *Dict.*, viii. 799 (1808).—*Drimys aromatica* F. Muell., *Pl. Vict.*, i. 20; Benth., *Fl. Austr.*, i. 49. These species must now take the name of *D. lanceolata.*

replaced in the genus *Drimys*, we usually, it is true, see only two pluri-ovulate carpels, of which the ovules do not generally attain their



Drimys (*Tasmannia*) *lanceolata*.

FIG. 206.
Male flower.

FIG. 207.
Longitudinal section of flower.

full development. The number of petals varies; there are sometimes half a score.[1] But in certain flowers there are only three or even

Zygogynum Vieillardi.
FIG. 208.

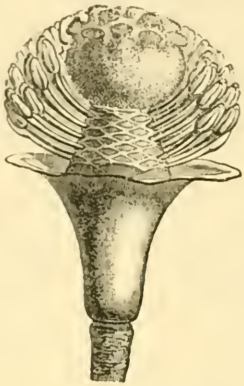
two; and this latter number is by far the most frequent in the species thence named *D. dipetala*.[2]

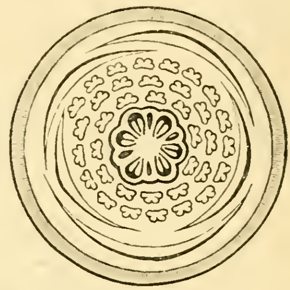
[1] In the cultivated plant certain flowers have as many as twelve. The calyx when adult forms a sac, and tears irregularly on anthesis. We have been able to follow its development, and have ascertained that when very young it is represented by two or three short free leaves. But soon a common membrane raises them to form the sort of nearly closed sac we have described. This is the usual mode of formation of a gamosepalous calyx. At the summit alone do we find two or three unequal teeth, the signs of the primitively distinct leaves.

[2] F. MUELL., *Pl. Vict.*, i. 21; BENTH., *Fl. Austr.*, 49, n. 2.—*Tasmannia dipetala* R. BR., ex DC., *Prodr.*, i. 78.—*T. insipida* R. BR., ex DC., *Syst. Veg.*, i. 445.—*T. monticola* A. RICH., *Voy. Astrol.*, 50, t. 19.

Thus constituted,[1] the genus *Drimys* extends over a vast geographical area. About half a dozen species compose it, of which two are Australian; while America, Borneo, New Caledonia, and New Zealand as yet possess each a peculiar species.[2]

Zygogynum[3] (figs. 208–210), which we recently observed in a herbarium from New Caledonia, is a singular genus, which we should





Zygogynum Vieillardi.

Fig. 209.
Flower (petals removed).

Fig. 210.
Diagram.

have placed in a separate section because of the peculiar organization of its gynæceum, if its flowers did not present all the other characters of *Drimys*. The gynæceum consists of a large number of carpels with multiovulate ovaries on a short cylindro-conical axis; but these are so united (fig. 209) that on the surface of the common gynæceum we only perceive a certain number of vertical grooves of no great depth, indicating the dorsal walls. The summit alone of each carpel is free as a small, very short style with a depressed capitate stigma. In fine, *Zygogynum* is a *Drimys* with syncarpous fruit. The androceum is the same in both genera. The corolla consists of a few, usually only four or five, unequal, thick, coriaceous, concave petals, much imbricated. As for the calyx, it is only represented by a small circular rim at the base of the corolla, formed simply by an expansion of the floral peduncle.[4]

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1 *Drimys.* Sections 4. { 1. *Eudrimys.* 2. *Sarcodrimys.* 3. *Winterana.* 4. *Tasmannia.*

2 Miers, *loc. cit.*, 132–140. — J. Hook., *Fl. N.-Zel.*, 12.—H.B., *Voyag.*, Bot. (1813), i. 205, t. 58.—A. S. H., *Pl. Us. Brasil.*, t. xxvi-xxviii.—Eichl., in Mart. *Fl. Bras.*, *Magnoliac.*, 133, t. 30, 31.

3 H. Bn. *Adansonia*, vii. 296, 372.

4 The study of the organogeny of this plant will alone reveal whether the rim is of appendi-

This is short, thick, and terminal, articulated at the summit of the branch. As yet but one species of this genus is known[1]—a small tree from the mountains of New Caledonia. Its leaves are alternate, petiolate, exstipulate; analogous to those of a *Magnolia* with persistent foliage.

IV. EUPTELEA SERIES.

The genus *Euptelea*[2] has been recently referred by HOOKER & THOMSON[3] to the order *Magnoliaceæ*, of which its polygamous flowers wanting the perianth present a much reduced type. In those which are hermaphrodite, the somewhat dilated summit of the receptacle[4] bears a variable number of stipitate free carpels, and around them are also an indefinite number of hypogynous stamens. Each of these consists of a slender filament and a basifixed linear anther, with two adnate cells dehiscing by lateral marginal clefts, and surmounted by an apiculate prolongation of the connective. Each carpel consists of a one-celled ovary supported on a slender foot, and surmounted by a sort of sessile crest covered with stigmatic papillæ, and descending along the inner edge of the carpel nearly to the point where the ovules are attached.[5] These are inserted on the internal angle of the cell on a parietal placenta which usually bears a single descending ovule, with its micropyle outwards and downwards in *E. polyandra* SIEB. and ZUCC.,[6] a Japanese species; while a second observed in India, *E. Griffithii* HOOK. F. & THOMS.,[7] possesses as many as three or four descending or slightly ascending ovules in each carpel. The male flowers contain only little sterile carpels.[8] The fruit consists of a variable number of stipitate samaras, each

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cular origin like the calyx of *Drimys*, or whether it arises later by a sort of annular hypertrophy of the calyx, closely analogous in form to that seen around the true calyx of *Eschscholtzia*.

1 *Z. Vieillardi* H. BN., *loc. cit.*, t. iv.

2 SIEB. & ZUCC., *Fl. Jap.*, i. 133.—ENDL., *Gen.*, n. 1850[1] (Suppl. ii. 29).—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 66.

3 *Journ. Linn. Soc.*, vii. 240.—B. H., *Gen.*, 954.

4 This summit often produces a small irregular circular ring around the stamens; but this appears to be of wholly axial nature. The study of organogeny will alone show whether it is developed like a disc.

5 "*Stigmata sessilia, linearia, a vertice carpellorum usque ad ovulorum insertionem introrsum decurrentia.*" (B. H., *loc. cit.*)

6 *Op. cit.* 134, t. 72.

7 *Loc. cit.*, t. 2.

8 The ovary, however, contains a single ovule in the Japanese species, but it remains sterile. SIEBOLD & ZUCCARINI say that there are female flowers without any rudiments of male organs (?).

containing from one to four seeds, which possess copious fleshy albumen surrounding a small embryo placed near the apex.

The *Eupteleas* are trees differing widely in aspect from most *Magnoliaceæ.* Their scaly buds develope alternate petiolate, exstipulate, caducous leaves, with a rounded or heart-shaped penniveined blade fringed with glandular teeth when young. The flowers appear before the leaves, and are collected into very short catkins also in scaly buds.

Next to *Euptelea,* we may provisionally station *Trochodendron,*[1] which might also constitute a particular section, because its receptacle assumes a markedly concave form, and the carpels, instead of being quite free, are partly imbedded by the base in the sort of axial cup thus formed. Hence the stamens inserted on the rim of this cup are slightly perigynous. They are, moreover, indefinite as in *Euptelea,* and each consists of a free filament and a two-celled adnate basifixed anther dehiscing by two longitudinal, nearly marginal, clefts.[2] Around the androceum we see no true perianth, but only some slight projections of the receptacle.[3] The carpels are of an indefinite but small number.[4] The way their ovaries are inserted on the receptacle makes them appear united for a large extent on the outside. But on the inside they are far more deeply separated, and are quite free in the stylar portion, which has the shape of a horn recurved at the tip, and traversed down the inner edge by a longitudinal groove, whose lips are covered above with stigmatic papillæ. Each ovary contains on its inner angle a two-lipped placenta bearing a variable number[5] of horizontal anatropous ovules. The fruit consists of several follicles united by the common receptacle below and externally, free above, and dehiscing by an internal vertical cleft. The numerous seeds contain fleshy albumen and an embryo of small size.

But one species of this genus is as yet known,[6] a Japanese tree

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[1] SIEB. and ZUCC., *Fl. Jap.*, 83, t. 39, 40.—ENDL., *Gen.*, n. 4714.—MIERS., *Contrib.*, i. 144.—EICHLER, in *Flora* (1864), 449; (1865), 12; *Journ. of Bot.*, iii. 150; *Flor. Bras. Magnoliac.*, 131.—B. H., *Gen.*, 17, 954.—*Gymnanthus* JUNGH., in HOFV. and DE VRIESE, *Tijdschr.*, vii., 308 (nec AUCTT.).

[2] The clefts are somewhat nearer the outer than the inner face of the anther. The connective ends in a somewhat projecting, rather obtuse tip.

[3] These are a sort of unequal horizontal wrinkles, whose existence even is not constant. Perhaps, indeed, they are only the effects of desiccation.

[4] There are often from six to eight.

[5] There are often six in each row. The raphes of those of the one row are turned towards those of the other.

[6] *T. aralioides* SIEB. and ZUCC., *loc. cit.* The habit and foliage do, in fact, recall those of several *Araliaceæ,* an order to which BENTHAM &

with scaly buds, and alternate, petiolate, crenulate, persistent leaves. The flowers, also proceeding from scaly buds, and almost always hermaphrodite, are arranged in bunches as in *Euptelea*, and appear at the commencement of the vegetation of the season. The scaly bracts, which at first protected them, fall off towards the time for their expansion. We can see from the foregoing that this group, to which the name of *Trochodendreæ*[1] has been given, includes two quite degenerate genera of *Magnoliaceæ*, with diclinous achlamydeous flowers. The insertion of the stamens in *Trochodendron*, and the concave form of the receptacle, which takes away all appearance of independence from the basilar portion of the carpels,[2] might authorize our establishing for these a small group of perigynous *Magnoliaceæ*.

V. CANELLA SERIES.

The *Canellas*[3] (figs. 211–215) are plants with regular hermaphrodite flowers. On the slightly convex receptacle are successively inserted a calyx and corolla of free pieces, an androceum and a gynæceum whose elements cohere by their edges. The calyx consists of three free persistent sepals,[4] imbricated in the bud (fig. 213). The

HOOKER had first referred *Trochodendron* as an abnormal genus. It appears, however, that a second species of this genus has recently been discovered in Japan, *T. longifolium* MAXIM., known to us only by the mention made of it by MIQUEL, in his work on the *Origines de la Flore de Japon* (see *Adansonia*, viii. 211).

[1] HOOK. F., *loc. cit.*

[2] The sort of shallow sac or cup formed by the dilated receptacle is here, in our opinion, of axial nature, and its organic base corresponds with the level of the insertion of the androceum. Consequently this sac is not of foliar origin, and hence gives insertion to the carpels. These are truly free as those of most *Magnoliaceæ*, but the base by which they are inserted is much extended and very oblique. Thus we have a great resemblance between the organization of the flower of *Trochodendron* and that of certain *Rosaceæ*, of *Eupomatia* among the *Anonaceæ*, and of most of the *Monimiaceæ*. For it is true that strictly, one may consider the sac surrounding the flower in the last named order as a calyx when it only supports stamens; but when, in the female flower, it gives insertion to organs of such complexity as the pistil, and that for a good way up, and even near its edges, it becomes difficult to admit that it is of appendicular origin. If we suppose the organic apex—that is, the deepest point—of the receptacle of *Trochodendron* to be pulled upwards and raised a little above the insertion of the stamens, we get a convex receptacle like that of *Illicium* or *Drimys*.

[3] P. BROWNE, *Jamaic.* (1756), 275, t. 27.—SWARTZ, in *Linn. Trans.*, i. (1791), 96, t. 8.—MURR., *Syst. Veg.*, 443.—GÆRTNER, *Fruct.*, i. 373, t. 77.—A. L. JUSS., in *Mém. Mus.*, iii. 347.—DC., *Prodr.*, i. 563.—ENDL., *Gen.*, n. 5457.—A. RICH., *Fl. Cub.*, 245.—MIERS, in *Ann. Nat. Hist.*, sér. 3, i. 348; *Contrib.*, i. 112, t. 23.—PAYER, *Fam. Nat.*, 102.—B. H., *Gen.*, 121, n. 1.—H. BN., *Adansonia*, vii. 12, 67.—*Winterania* L., *Gen.*, n. 598.—JUSS., *Gen.*, 263.

[4] To BENTHAM & HOOKER these three leaves represent bracteolæ, forming a sort of calyculus under the flower, which would then be apetalous in *Canella*; for these botanists call that coloured perianth a calyx which most other authors call a

corolla is formed by five petals of imbricative or contortive æstivation, of which four are in pairs alternate with the sepals, while the fifth alone (fig. 213) answers to the interval between two sepals.[1] The stamens, about twenty in number,[2] are monadelphous; their hy-

Canella alba.
FIG. 211.

pogynous filaments being united into one tube, as are the connectives, which are slightly separated quite close to their apex by more or less marked crenulations. On the outer surface of the sort of collar thus formed by the androceum are applied the vertical, linear, one-celled extrorse anthers, which dehisce by a single longitudinal median cleft, whose edges spread and turn outwards.[3] The gynæ-

corolla. The arrangement of the parts of this floral envelope in *Cinnamosma* rather seem to indicate that it represents a corolla analogous to that of the *Ebenaceæ*.

[1] PAYER has observed (*loc. cit.*) that these five petals are arranged with regard to the sepals as if of three alternate petals two had become deduplicated, and compares this arrangement to that seen in *Helianthemum*.

[2] PAYER regarded them as ten bilocular stamens—five opposite the petals, and five alternate with them. This view he, no doubt, based on the fact that the dentations or crenations borne at the summit of the androceal collar are usually ten in number, each corresponding with the apex of a connective. But it is difficult to admit this explanation when the whole number of cells is odd, as often happens; sometimes fifteen or seventeen may be counted.

[3] The pollen is very much like that of *Magnolia*, fusiform, with a longitudinal cleft. (See *Comptes Rendus*, lxvi. 700; *Adansonia*, viii. 157.)

ceum, whose apex alone is seen through the superior opening of the staminal tube, consists of a free ovary, tapering above into a style, which is somewhat dilated at the tip, and obscurely divided into tubercles covered with stigmatic papillæ. The ovary is one-celled, with two or three parietal placentas superposed to the sepals, each bearing several descending,[1] somewhat curved, subanatropous ovules, with the micropyle looking upwards and inwards (fig. 214). The fruit is a polysper-

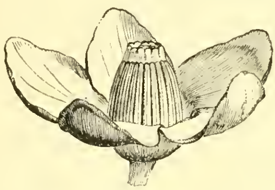


Fig. 212.
Flower.

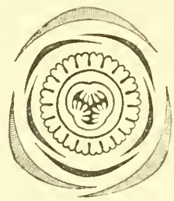
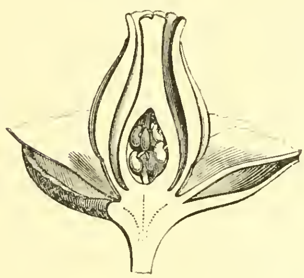
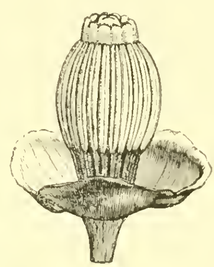


Fig. 213.
Diagram.





Canella alba.

Fig. 214.
Longitudinal section of flower.

Fig. 215.
Flower without the corolla.

mous berry, and the seeds contain copious fleshy albumen, which lodges a tolerably long curved embryo near the apex and back of the seed.[2]

Of this genus but one or two species are known, of American origin. Of these the chief is *C. alba*,[3] the plant which furnishes the

[1] On each placenta there may be two, three, or four, rarely more, inserted at different heights. Each is suspended by a short, very slender funicle, which descends very obliquely from the edge of the placenta to be inserted into the middle of the concave edge of the ovule, where it becomes continuous with the raphe.

[2] The outer seed-coat is thick, crustaceous, and shining; the inner, soft and membranous. Around the hilum is a small, circular, whitish, rudimentary aril. The albumen is fleshy, very copious; the embryo, about half as long as the albumen, is quite eccentric, placed on the opposite side to the raphe, with its often somewhat unequal cotyledons downwards. The micropyle forms a short, slightly curved beak. There may be as many as half a dozen seeds in the berry, whose thin skin is lined by a pulpy layer of no great thickness.

[3] Murr., *Syst. Veg.*, 443.—*C. Winterania* Gærtn., *loc. cit.*—*Winterania Canella* L., *Spec.*, 636.—Poir., *Dict.*, viii. 799; *Illustr.*, t. 399.—Miers, *op. cit.*, 116, n. 1, t. 23 A. The second species admitted by Miers (*loc. cit.*, 118) under the name of *C. obtusifolia*, which grows in Maracaibo, is perhaps only a variety of the former.

Canella alba bark, a native of the Antilles, cultivated in our conservatories and in most hot countries. It is a small tree, all the parts of which are very aromatic and glabrous. The leaves are simple, alternate, exstipulate, covered with pellucid glandular dots. The flowers are placed at the ends of the branches in bunches of ramified, often dichotomous cymes. The secondary axes of the bunch are axillary either to the highest leaves on the branch (fig. 211), or to more or less caducous bracts which succeed the normal leaves. Thus the inflorescence as a whole constitutes a sort of thyrse or panicle.

C. axillaris,[1] which grows in Brazil, has become the type of a special genus, under the name *Cinnamodendron*,[2] because its perianth is lined with a certain number of flattened petaloid scales,[3] and its flowers, instead of being collected at the summit of the branches, are grouped into short bunches, in the axils of the leaves themselves. Otherwise the flower presents nearly the same general organization. The corolla consists of four or five imbricated leaves. The scales within these are equal, or nearly equal, in number, alternate with them, and caducous. There are a score of stamens in the androceum, and the unilocular ovary contains four or five pluriovulate placentas. The fruit is a polyspermous berry, with a gelatinous pulp surrounding the seeds. Another species of the same genus, *C. corticosum* MIERS,[4] grows in the Antilles. Its bunches are also lateral, or axillary, few flowered. The flowers, far larger than in the preceding species, are pentamerous. The corolla is doubled with five small obovate imbricated scales. The androceum consists of a score of stamens, and the one-celled ovary contains from three to five parietal placentas, supporting an indefinite number of descending ovules. These two species are small aromatic trees, with alternate exstipulate leaves. The genus may be defined as *Canella*, with terminal flowers, and the perianth doubled with appendages of contested morphological significance.

In a new genus, of similar organoleptic properties, but belonging

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[1] NEES & MART., *Nov. Act. Acad. Cæsar.*, xii. 18, t. 3.—SPIX & MART., *Reise*, i. 83; ii. 336.

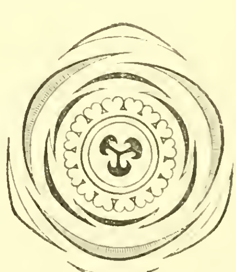
[2] ENDL., *Gen.*, n. 1029.—MIERS, *Ann. of Nat. Hist.*, ser. 3, i. 350; *Contrib.*, i. 118, t. 24.—B. H., *Gen.*, 121, n. 2.—H. BN., *Adansonia*, vii. 14, 67.

[3] These organs (glands or staminodes ?) are the true petals in the opinion of BENTHAM & HOOKER. The number varies somewhat: it is often the same as that of the more external leaves which we have just described as the pieces of a corolla.

[4] *Contrib.*, i. 121, n. 2, t. 24 B.

to the Old Continent, which we have named *Cinnamosma*[1] (figs. 216–219), the flowers are sessile and solitary in the axils of the leaves, which gives the plant a strong resemblance to certain species of *Diospyros*. The three sepals are accompanied by several external bracts, like them, but shorter as they are more external. The

Fig. 216.



Cinnamosma fragrans.

Fig. 217. Flower.

Fig. 218. Longitudinal section of flower.

Fig. 219. Diagram.

androceum presents about fifteen stamens, united to form a sort of collar, as in *Canella*. The ovary, too, is one-celled, with three or four pauciovulate placentas.[2] The ovules are descending,

[1] H. Bn., *Adansonia*, vii. 217, 377, t. v.—B. H., *Gen.*, 970.

[2] There are most usually only two ovules on each placenta, one on each side; they are not quite on a level, and are of the same form as in *Canella*.

with the micropyles looking downwards and inwards. The fruit is a many-seeded berry,[1] but the most striking character of this genus is its gamopetalous corolla, whose tube elongates as it grows older, and whose limb, first spreading and afterwards reflexed, is divided either into five quincuncial lobes, whose position with regard to the sepals is the same as in *Canella*, or in six lobes, of which three are external and three internal. *C. fragrans*, the only species known, is a small tree with alternate exstipulate aromatic leaves, which as yet has only been observed in the north of Madagascar. It may be defined as a *Canella*, with solitary axillary sessile flowers and a gamopetalous corolla.

Having ascertained and discussed the characters of the eleven genera that we retain in this order, let us now see how each in succession has come to be placed in it. B. DE JUSSIEU[2] had ranked in his *Tiliæ* the *Magnoliaceæ* properly so called—*i.e.*, the genera *Liriodendrum* and *Magnolia*. *Illicium* alone was placed among his *Anonæ*. ADANSON,[3] far more logical, included in one and the same order the *Anonæ*, the genera *Illicium* (under the name of *Skimmi*), *Magnolia*, *Champaca* (*Michelia*), and *Tulipifera*. As we also find *Dillenia* and *Menispermum* in this family, it is evident that this genius left nothing of the true affinities of *Magnoliaceæ* to be discovered by modern botanists. A. L. DE JUSSIEU[4] had simply to divide the *Anonaceæ* of ADANSON into two nearly equal parts : he separated *Anona* and several nearly allied genera to constitute his order *Anonæ*, and left as true *Magnoliaceæ* the genera *Drimys*, *Illicium*, *Michelia*, *Magnolia*, *Talauma*, and *Liriodendrum*. Unfortunately, to these he added *Euryandra* (*Tetracera*) and *Mayna*, and also *Dillenia*, *Curatella*, *Ochna*, and *Quassia*, as "*genera affinia*." Still, thenceforward four of the genera which we retain as distinct in *Magnoliaceæ* were united into one group. *Canella* was placed among the *Meliæ*. The genus *Schizandra*, taken by BLUME[5] as the type of a separate order, *Schizandraceæ*, retained as distinct by authors until 1862,[6] was then referred

[1] The seeds are surrounded with the same sort of pulp as that which is so abundant in *Cinnamodendron*. They are probably of similar structure to those of *Canella*, but have not yet been studied when quite ripe.

[2] Ex A. L. JUSS., *Gen.*, lxviii.

[3] *Fam. des Plant.*, ii. 364.

[4] *Gen.*, 280, *ordo* xv.

[5] *Bijdraj.* (1825), 21.

[6] ENDL., *Gen.*, 835.—MEISNER, *Gen.*, 5.—LINDL., *Veget. Kingd.*, 305.

to *Magnoliaceæ* by Bentham & Hooker. Still later, Miers[1] proposed to put the *Canelleæ* near the *Winteraceæ*, which included *Illicium* and *Drimys*. The old genus *Canella* was at the same time split up by him to permit the establishment of his genus *Cinnamodendron*. Siebold[2] had in 1835 described *Trochodendron*, which he put near *Magnoliaceæ*. Bentham & Hooker[3] had made it an abnormal Araliad. But Hooker & Thomson[4] were decided by the arguments of Eichler,[5] and the comparison they were able to make with *Euptelea*,[6] another Japanese genus, at one time referred to *Ulmaceæ*, to restore the two last-named genera to *Magnoliaceæ*. Thus was raised to nine the number of genera, which according to us should form part of the order. We have added two others, *Zygogynum*,[7] a Drimyd with a syncarpous ovary, and *Cinnamosma*,[8] a gamopetalous Canellad.

Of all the characters presented by plants of this order, there are only three absolutely constant, and it must be owned that even these possess but little value of themselves: they are, woody stem, alternate leaves, and albuminous seeds. We can conceive that some time or other a Magnoliad might be found wanting any of these characters, and yet such that we could not on that account exclude it from this order. But beside these absolute characters, we have a very large number of others so general that their extremely rare absence (often observed in a single genus only) is sufficient to determine an important tribe or genus. Hence it is on these almost constant characters that we must lay stress. Eight may be enumerated—

1. The form of the floral receptacle.—This, so important on account of the mode of insertion which directly results from it, is more or less concave in the two genera *Euptelea* and *Trochodendron* only, and especially in the latter; it suffices to characterize the series of *Eupteleæ* or *Trochodendreæ*.

2. Again, these two genera alone lack a true perianth; the absence of calyx and corolla is an equally good characteristic of this series.

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1 *Contrib.*, i. 112.
2 *Fl. Jap. Fam.*, 133.
3 *Gen.*, 17.
4 *Journ. Linn. Soc.*, vii. (1863), 240.
5 Mart. *Flor. Bras.*, *Magnoliac.*, 131; *Flora* (1864), 449; (1865), 12; Seem., *Journ. of Bot.*, iii. (1865), 150.
6 Established by Siebold & Zuccarini in 1835.
7 In 1867; see p. 156, note 3.
8 In the same year; see p. 163, note 1.

3. In all the genera in which we can obtain any distinction of the perianth into calyx and corolla, the edges of the pieces of these floral envelopes overlap one another in the bud, and the calyx is imbricated.—In *Drimys* alone does it constitute a sac more or less raised, and valvate in æstivation; this has hitherto sufficed to characterize this genus among the *Illiceæ*, of which it might form a well marked subsection.

4. The corolla, when distinct, is always polypetalous.—There is only one genus of the *Canelleæ*, *Cinnamosma*, in which it is distinctly gamopetalous.

5. When the ovules are solitary, or very few in number in each carpel, of a descending direction, they have their micropyles turned upwards and outwards, which would indicate that if ascending, the micropyles would look downwards and inwards.—In *Illicium* alone the solitary ovules are ascending, and the micropyle looks downwards and outwards; this is sufficient to characterize a special subsection *Euilliciea* among the *Illicieæ*.

6. In one genus alone the carpels, each containing a single placenta in the internal angle, are united into a plurilocular ovary.—Everywhere else, where the placentas are so arranged, the carpels are free. Thus we recognise *Zygogynum*, which might strictly be considered as a special syncarpous subsection of *Wintereæ*, or *Illicieæ*.

7. In *Canelleæ* alone, on the other hand, the carpels, united edge to edge, form a single unilocular ovary, with several parietal placentas.—These plants are then to this order what *Monodora* is to the *Anonaceæ*, *Berberidopsis* to *Berberidaceæ*, *Lardizabalaceæ*, &c. (see p. 119).

8. Only in the two genera forming the true *Magnoliaceæ* do we find stipuliform expansions at the base of the leaves; and of these all the species do not possess this character; but it is wanting in all the other members of the order.

All the other characters vary in passing from one genus to another, or in a single genus in passing from one species to another. These are as follows: the consistency of the fruit, its dehiscence (if it opens when ripe), the number of perianth leaves and of sexual organs, the number of ovules in each cell, the aspect of the anthers, the existence of dots on the leaves, &c. The subdivisions of minor importance alone, then, may be founded on these characters.

We have shown how, assisted by these differences in structure,

we can in practice divide the order into five series, which are as follows—

1. Magnolieæ.—The floral axis is cylindro-conical, often much elongated. The spiral arrangement of its appendages is very manifest. The pieces of the perianth are imbricated. The flowers are hermaphrodite. There are two horizontal or descending ovules with the micropyle upwards and outwards. The leaves often present stipuliform dilatations.

2. Schizandreæ.—The floral axis, at first short, remains so, or becomes elongated, as in *Magnolieæ*. The spiral arrangement in the latter case becomes evident. In each carpel are two descending ovules, with the micropyle downwards and outwards. But the fruit is always fleshy, and the flowers are unisexual. The stem is usually climbing; the leaves are exstipulate.

3. Illicieæ.—The floral axis is short, and the spiral insertion which really exists is but slightly apparent. The ovules are solitary and ascending, with the micropyle outwards (*Euillicceæ*), or in larger numbers in two vertical rows (*Drimydeæ*). In the latter case the calyx is valvate. There are no stipules.

4. Eupteleæ.—The floral receptacle is short, and more or less concave. The perianth is wanting. The flowers are polygamous, and the leaves exstipulate.

5. Canelleæ.—The floral appendages are verticillate. The corolla is polypetalous, or gamopetalous. The stamens are monadelphous, with extrorse anthers. The ovary is unilocular, with several parietal placentas. The fruit is fleshy. The leaves are exstipulate.

All the *Magnoliaceæ* as yet known are woody plants, but their dimensions are most variable. Thus in the genus *Magnolia* alone, we meet with gigantic trees, and with little shrubs not half a yard high. The *Canelleæ* and *Illicieæ* are usually small trees or shrubs. A single species of the genus *Drimys* may become a very tall shrub, or a stunted undershrub a few inches high, according to the country and soil where its numerous varieties grow. The *Schizandreæ* are, on the contrary, creeping or climbing lianas. The stems of certain *Magnoliaceæ* have long been pointed out as presenting remarkable peculiarities of structure in their wood. That of *Drimys*, and of *Tasmannia*, which was formerly considered as a distinct genus, was

remarked by LINDLEY[1] for possessing areolate punctations like those of the Conifers, or rather of *Araucaria*. This assertion has since been confirmed by several observers.[2] Further, these plants have no other vessels than those few we find outside the pith in a branch one year old, of which only a small number are true tracheæ, with a thread that can be unrolled. The other woody layers, produced afterwards at different periods of vegetation, consist only of fibres with areolate dots. *Trochodendron*, whose place among *Magnoliaceæ* had been considered doubtful, presents the same peculiarity.[3] The *Magnolieæ* and *Illicium*, on the contrary, have vessels in concentric zones, alternating with those of woody fibres, and in this respect return to the common plan of structure in Dicotyledons; so does the genus *Euptelea*,[4] very closely allied to *Trochodendron*. Hence there is no absolute character common to the whole order to be found in the relative distribution of the vessels and the fibres. But we have shown in a memoir which we reproduce below,[5] that the stems of *Magnoliaceæ*, observed when young, present a character in the pith which is far more general than that above mentioned; that the existence of special cells almost always enables us to recognise them on seeing only a fragment of a branch or stem; and that, finally, the arrangement of these cells is, moreover, often sufficient to characterize one of the series that we admit in this order.

"One of the true *Magnolieæ*—that is, a *Magnolia* or a Tulip-tree—is usually recognised by the following histological character: its whitish pith is divided into segments by a series of transverse diaphragms of a more or less yellowish or greenish tint. These septa

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[1] See *Veget. Kingd.*, 417.

[2] GŒPPERT, *Ueber die Anat. Struct. ein. Magnoliac.*, *Linnæa*, xv. (1842), 135; *Ann. Sc. Nat.*, sér. 2, xviii. 317.—OLIVER, *Struct. of the Stem in Dicotyl.*, 2.—EICHLER, MART. *Flor. Bras.*, *Magnoliac.*, 139, t. 32. There is, however, a slight difference between the stems of a *Drimys* and *Araucaria* as regards the general direction of the cells of the medullary rays, which have their longest diameter vertical in the former, radial in the latter.

[3] EICHLER, *Flora* (1864), 449; SEEM., *Journ. of Bot.*, iii. (1865), 150.

[4] OLIVER, *op. cit.*, 3. The fibres and vessels here present punctations. The parenchyma is covered with longitudinal rows of perforations, "at least, on the surfaces transverse to the medullary rays." A. GRAY (*Introd. to Bot.*, 1858, 43, fig. 47) has represented these punctations in *Illicium*. Those of *Wintereæ* and *Canelleæ* were noticed and compared with one another by MIERS (*Ann. Nat. Hist.*, ser. 3, ii. 34). GRIFFITH has made out (*Notul.*, iv. 715) the existence of oblique perforations in the fibres of *Kadsura*; and LINDLEY (*Intr. to Bot.*, i. 66, 20) has figured those of *Sphærostema*. The *Schizandreæ* often contain large parallelopipedal or prismatical crystals in their parenchyma, especially that of the pith. In *Drimys* we have found cells with bundles of raphids, but only very rarely.

[5] *Compt. Rend. de l'Acad. des Sciences*, lxvi. 698; *Adansonia*, viii. 155.

are formed of peculiar cells, elongated horizontally, and becoming deformed or bent where they come in contact with the medullary sheath. They owe their coloration to their contents; and the outer wall is at once distinguished by the numerous canals by which it is perforated, by the way it refracts light, and by its great thickness. Though this character varies from one species to another, and even in a single species, according to the conditions under which it grows, we may rank these peculiar cells in the category of those termed '*Steinzellen*' in Germany. *Drimys* and *Schizandra* present similar *stony cells* [Fr. *cellules pierreuses*] in their medullary parenchyma; but their arrangement presents characteristic differences.

"In the pith of a young branch of *Drimys Winteri*, or any of its varieties, especially *D. granatensis*, we here and there see cells, near together or separated, which gradually lose the primitive thinness of their walls. Their form varies somewhat with age, for they may have all their diameters equal, or become vertically elongated and fusiform as they grow older. Their walls become thickened by internal increments only, for the numerous cylindrical openings by which they are perforated early cease to be of uniform calibre throughout. The thickening is less marked towards the two orifices of the canal, and especially the internal one, so that soon each canal has the form of a cylinder, widening out into a cone towards each orifice. Hence results the formation of a fusiform cavity by the union of two canals belonging to neighbouring cells, whose orifices exactly correspond; hence also the areolate appearance of the punctations when seen from above, like that presented by Conifers. The contents of these *stony cells* are of a yellow or brown tint in specimens brought from their native country. These cells, then, are physiologically comparable to those which form granular aggregations in the cortical parenchyma.

"The pith of *Schizandra* is often of a uniform green tint, due, in the first place, to the green matter contained in the ordinary cells of its parenchyma. It is further studded with *stony cells*, with deeply coloured contents, arranged either in vertical rows or without any apparent order. Some *Sphærostemas* present peculiarities in these vesicles which demand a special description.[1] Often these cells,

[1] In these nearly cylindrical cells we find on the inside of the walls a sort of nearly colourless crystallization, formed of very unequal irregularly facetted fragments of high refractive index, and

which differ from the rest of the parenchyma in their much greater consistency, may be isolated from it simply by the pressure of the covering glass of the slide, which disengages without crushing them.[1]

"It is impossible to avoid considering these scattered cells, as of the same nature with those which form septa in the pith of the *Magnoliceæ*. Thus the whole order is characterized by the identity of the structure of these utricles, while their different modes of arrangement serve to distinguish the tribes: *stony cells*, disseminated in *Schizandreæ* and *Wintereæ*, collected into diaphragms in *Magnolieæ*. In the rapidly-developed shoots of some *Magnolias* we have seen these septa reduced to a single *stony cell*, nearly central, on which all the surrounding cells of the ordinary parenchyma abut by one end, bent, or drawn out in a quite peculiar fashion.

"Moreover, the sarmentose stems of the *Schizandreæ* are distinguished from those of the *Wintereæ* by another anatomical character. Towards the outside of the fibrovascular zone, they present wide vertical tubular cavities, lined with a fine membrane and riddled with very minute perforations; very often becoming detached from the walls of these cavities in long cylinders which at once collapse."

The bark of certain *Magnoliaceæ* presents peculiarities of structure often related to the use made of this part of the stem in several species we shall enumerate below.[2] Several years ago Gœppert[3] pointed out in the bark of *Drimys Winteri* certain small granulations visible even to the naked eye, and remarkable for their consistency. They consist of *stony cells*, dotted, perforated, and often areolate, which correspond pretty closely in structure with the better developed ones which we have described in the medullary parenchyma.[4] When adult, their contents are nearly colourless, or more

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simulating a thick coat of polyhedral starch-granules. But these bodies, unattacked by water, are not dyed blue by tincture of iodine. In the pericarp of *M. Yulan* Desf., Millardet has recently ascertained that the cells of the pericarp contain in the thickness of their walls, "a real network of canaliculi ramifying in every direction," of which some contain crystals, and the presence of which would be an argument in favour of the thickening of these cellular walls by internal deposit (*Ann. Sc. Nat.*, sér. 5, vi. 309).

[1] Griffith (*Notul.*, iv. 715) has remarked in the parenchyma of *Kadsura*, a structure compared by Oliver (*op. cit.*, 3) to that observed in the stem of certain *Hamamelidaceæ*; that is—that in the interval between two fibres, we find very large lenticular cavities, whose centres abut on the openings of perforations in the walls of each fibre. Here again we have the same fact as in *Drimys* and the Conifers.

[2] Such are the following aromatic barks: Winter bark, Canella-alba bark, and those of *Cinnamodendron*, the Tulip-tree, and several *Magnolias* used in medicine.

[3] *Loc. cit.*—Eichler, *loc. cit.*, 138, t. 32.

[4] See p. 169. Here their various diameters are

frequently of a brownish or reddish tint; while originally there are both starch and green colouring matter. In the same plants, the cells of the cortical parenchyma, which remain thin-walled, are not all of the same dimensions. Here and there some of them become very large and rounded. Their contents, at first green, afterwards yellow, and more or less granular, consist of an oleo-ethereal, odoriferous, volatile substance, to which these barks owe most of their therapeutical properties.[1] The bark is markedly different in the *Canelleæ*,[2] not presenting those thick-walled cells so much developed in *Drimydeæ*. The outer cells form nearly homogeneous layers, having walls of nearly equal thickness; and within the bark we see the elongated liber cells much developed, forming flexuous bundles, which project like prisms or wedges into the parenchyma.

With such considerable variations in the structure of the fundamental organs, especially the flower, it is impossible that the *Magnoliaceæ* should not possess multiple affinities. And in the first place, we find that in organization they are very near most of the orders termed *Polycarpiceæ*, especially *Anonaceæ*, *Dilleniaceæ*, *Ranunculaceæ*, and *Menispermaceæ*. The *Anonaceæ*, which were, as we have seen, so long united with them, only differ in one character—their ruminated albumen. None of the other characters cited by authors is constant; neither the æstivation of the perianth, nor the presence or absence of stipules, nor the independence or union of the carpels, nor the union or separation of the sexes. *Eupomatia*, usually referred to *Anonaceæ*, especially on account of its ruminated albumen, has exactly the exstipulate leaves of certain *Magnoliaceæ;* and its carpels, sunk in the cavity of the common receptacle, are thus united together into a single mass with the styles alone distinct, like those of *Zygogynum*. The fruit of *Anonaceæ* is almost always indehiscent; but that of *Anaxagorea* consists of true follicles, like those frequently found in *Magnoliaceæ*. These last are also closely analogous to *Dilleniaceæ*. It is true that till very recently it might be remarked that the *Dilleniaceæ* are not aromatic, and that

more nearly equal, and they are rarely solitary, more usually aggregated to form irregular whitish masses.

[1] In time, a solid balsamic and resinous substance is produced, nearly homogeneous, and of a yellowish colour.

[2] EICHLER, *loc. cit.* This botanist has found that in *Drimys* the periderm and suber are wanting.

all *Magnoliaceæ* are more or less so, But this character, practically useful though it be, is certainly of no great importance in itself; and it has ceased to be absolute since the *Eupteleæ*, which lack all aroma, have been classed among *Magnoliaceæ*. Nor is the direction of the ovule of fundamental value in separating the two orders, because a descending ovule with the micropyle exterior, as in *Magnolia*, answers really to an ascending ovule with the micropyle interior, as seen in the uni or pauci-ovulate *Dilleniaceæ*. But here again, in practice, as we as yet know no *Dilleniaceæ* with definite and suspended ovules, we may assert that the ovules of *Magnoliaceæ*, solitary and few in number, have the micropyle always external, whether they be descending, as in the true *Magnolias* and *Schizandra*, or ascending, as in *Illicium*. In *Dilleniaceæ* with pauciovulate carpels the micropyle, on the contrary, looks inwards.

Moreover we must give up the attempt to distinguish *Dilleniaceæ* and *Magnoliaceæ* by the presence or absence of stipules, since the *Schizandreæ*, *Illicieæ*, and *Canelleæ* have no stipules, while certain *Wormias*, *Davillas*, &c., as we have said,[1] possess petiolar expansions which behave exactly like the organs called stipules in *Magnoliaceæ*. Nor is the symmetry of the flower sufficient to separate the two orders absolutely; for if it is true that the flower of *Dilleniaceæ* is often on a quinary type, it is equally true that that of *Magnoliaceæ* is far from being constantly composed of trimerous verticils. The *Dillenias* are almost *Magnoliaceæ*, as no one can fail to see on an exact analysis of their flowers. The quinary symmetry of the perianth, the verticillate arrangement of the carpels, the spiral insertion of the androceum,[2] the stipuliform dilatations of the petioles, are facts which are all met with in one or other of the types of the *Magnoliaceæ*.[3] These too are very near the *Calycantheæ*. It is true that as yet we have found none of the *Magnoliaceæ* with a receptacle

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[1] See p. 120, and *Adansonia*, vi. 271.

[2] As in the case of the *Ranunculaceæ*, we shall be able to take into account the development of the flowers in distinguishing *Magnoliaceæ* from *Dilleniaceæ*, as soon as the organogeny of the former has been more completely studied. We may now say that in all the *Magnoliaceæ* we have as yet studied, the androceum is developed, not centrifugally as in *Dilleniaceæ*, but in a spiral order and centripetally. This peculiarity is very marked in *Magnolia* and *Drimys*; it also exists in *Illicium anisatum* and *parviflorum*, though much less evidently (see *Adansonia*, vii. 361; viii. 12).

[3] We shall not here speak of the aril, which is said to be highly developed in *Dilleniaceæ* and absent in *Magnoliaceæ*, considering that the aril, as seen from our stand-point, is not of the same conformation in the two groups, but is really more generalized in *Magnolia* than in *Candollea*, *Hibbertia*, &c., all the superficial cells of the former genus entering into its formation by their hypertrophy (see p. 132, note 7).

as concave as that of the *Calycantheæ*, and that these last have always opposite leaves. But it may be said that the floral receptacle of a *Magnolia*, if pushed down so that its organic apex would be at the bottom of the cup thus formed, would become exactly that of a *Calycanthus* ; and long ago the striking resemblance of the flowers of *Chimonanthus*, those of *Illicium* and *Schizandra* was remarked. The herbaceous *Ranunculaceæ* may also recall the structure of the flower of *Magnolia*, e.g., *Myosurus* and the Crowfoots with an elongated receptacle. In the eyes of several authors the order *Magnoliaceæ* have representatives among genera with unilocular ovaries and parietal placentation. Such was *Mayna*, which is now-a-days restored to the order *Bixaceæ*, and which presents numerous affinities with the *Canelleæ*. In this last series we find genera with flowers closely analogous to those of some *Samydeæ*, and one plant whose habit, foliage, inflorescence, and gamopetalous corolla closely recall what is observed in *Ebenaceæ*, which are moreover closely allied to the neighbouring group, the *Anonaceæ*. Finally, the *Eupteleæ* include two genera of which it was at first possible to place the one, *Trochodendron*, among the abnormal *Araliaceæ*, while the other, *Euptelea*, presents more than one analogy, especially in its diclinous flowers and samaroid carpels, with some of the *Xanthoxylacaceæ* and *Simarubeæ*, like *Ailanthus*.

Of about seventy-five species belonging to this order nearly three quarters are found in the Old World. All the *Canellaceæ* were American, until the discovery of *Cinnamosma*. All the *Schizandreæ*, on the contrary, except the species taken as the type of the genus *Schizandra*, are foreign to America. The only three known *Eupteleæ* are Japanese. The species of *Illicium* are equally divided between both Worlds. *Drimys* is found in the whole of tropical and southern America, and from Borneo and the north of Australia to New Zealand. Among *Magnolieæ*, *Liriodendron* is the only exclusively American genus. The genus *Magnolia* is only represented in America by the *Eumagnolias* and some *Talaumas*. Australia has no *Magnoliaceæ*, except the section *Tasmannia* of *Drimys*. No representatives are known native in Europe and Africa.[1] Thus, of the eleven genera we admit in this work, four are common to both

[1] "Nor the adjacent islands." (R. Br., *Congo*, 465.)

Worlds; three are proper to the New World, and four to the Old. The latter possesses about fifty-five species of its own; the former about a score. We know of none found native in both.

The *Magnoliaceæ* are almost all useful to man. They only become noxious in some cases by the very excess of their virtues. Thus it is said that the too powerful scent of the flowers of *Magnolia Umbrella* and of several other species of the same genus has sufficed to cause headache, nausea, and nervous attacks. But in the open air the lemon-like scent of *M. grandiflora,* that which the species of the section *Talauma*[1] spread far and wide, and the yet sweeter odour of *M. pterocarpa* ROXB., *glauca, Yulan,* &c., are very agreeable, and cause these superb plants to be prized as ornaments in gardens,[2] as do the evergreen polished leaves of *M. grandiflora,* and the white or pink corollas of *M. Yulan, purpurea, Soulangiana, auriculata, macrophylla, glauca, Campbellii,*[3] *Kobus,*[4] &c. As drugs,[5] the *Magnolias* properly so-called are rich in a bitter, aromatic, tonic principle found in the bark of both root and stem, and especially the latter.[6] The bark of *M. grandiflora* (the *Tulip-Laurel, Big Laurel* of the Americans) is considered a tonic and slight febrifuge. That of *M. glauca* (*Blue Magnolia, Marsh Magnolia, Castor-tree, Beaver-tree, Virginian Cinchona, Swamp Sassafras* of the Americans) enjoys a far greater reputation.[7] This species was for some time thought to produce the *true Angostura bark,* which will show pretty clearly what are its virtues. From it is prepared an alcoholic tincture, which is a tonic stimulant[8] and febrifuge,

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[1] It is assevered that the flower of *T. fragrantissima* HOOK. (*Icon.* t. ccxi.), which we must refer to *T. ovata* A. S. H., can be smelt half a mile off.

[2] TREW, *Icon. Select.*, t. 9, 23, 25, fig. 2, 62, 63.—DUHAM., *Traité des Arbr.* (1775), ii. 2.

[3] HOOK. & THOMS., *Illustr. Pl. Himal.*, t. 4.—V. HOUTTE, *Fl. des Serres*, t. 1282–1285. This species has a bright pink perianth, and a pretty regular elongated fruit.

[4] KÆMPF., *Icon. Select.* (1791), t. 42.

[5] ENDL., *Enchir.*, 429.—PEREIRA, *Elem. Mat. Med.*, ed. 4, ii. p. ii. 674.—GUIB., *Hist. Nat. des. Drog. Simpl.*, ed. 4, iii. 678.—LINDL., *Fl. Med.*, 23.—ROSENTH., *Synops. Plant. Diaphr.*, 595.

[6] BLUME thought that these properties afforded a clear separation between *Magnoliaceæ* and *Dilleniaceæ*, which are not aromatic, but simply astringent.

[7] MICHX., *Arbr. Forest.*, iii. 77.—PEREIRA, *op. cit.*, 675. In the south of the United States this plant is also called *White Bay* and *Sweet Bay.* Its bark is removed in autumn and winter. When dry it occurs in light, smooth, somewhat quilled pieces, several inches long, and one or two inches broad, of a silvery ash colour outside, white and fibrous within. It has a warm, pungent, bitter taste, and an agreeable smell. The bark of the root is thought more active than that of the trunk. It is supposed to contain the same principle analogous to liriodendrine as that found in the bark of *M. grandiflora,* by S. PROCTER (*Amer. Journ of Pharm.*, xiv. 95). The preparations usually used are the powder, the alcoholic infusion, and the decoction.

[8] According to BARTON it is so powerful an excitant, that when improperly administered it may determine attacks of fever or rheumatism.

and appears very efficacious in chronic rheumatism.[1] *M. acuminata* and *auriculata* are known in the same country as *Cucumber-trees*;[2] and their bark, infused in various alcoholic liquors, is used by the people of the mountain districts in rheumatic affections and intermitting fevers. The leaves must possess similar properties, but are very little used. The flowers are used to prepare perfumes of but slight stability. Those of *M. Yulan* are used in China to give an aroma to tea; its buds are pickled in vinegar, and the fruits are also used in infusion, as pectoral and demulcent, in cases of cough and other pulmonary affections, and in catarrhal fever. The alcoholic infusion of the green fruits of the Cucumber-tree is also thought to cure rheumatism. Those of *M. glauca* are as useful as the bark. The seeds of many species, such as *M. glauca, acuminata, Yulan*, are much used as febrifuges. It is said that those of *M. grandiflora* are used to treat paralysis of every description, and that those of *M. Yulan*, prized in China[3] for the lemon scent of their fleshy coats, cure chronic rheumatism; they are also powdered in that country for a sternutatory. The wood of the species of this section is of no great value; it is usually white, of but little hardness or durability, and too light and spongy. Accordingly, that of *M. grandiflora* and *auriculata* is only used in America for the internal beams of houses. That of *M. acuminata* is hardly stronger, but has a fine grain, and easily takes a high polish, which brings out its brownish yellow colour; and it is much used in the woodwork of houses.

In the *Magnolias* of the section *Talauma* the aromatic properties are still more marked. The intense scent of their flowers in conservatories may bring on faintness. It is to those of *M. Plumieri*[4] or *Talauma Plumieri*[5] (*Bois Pin, Bois Cachiment* of the Creoles), that, according to L. C. Richard,[6] the excellent table liqueurs of Martinique

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[1] Bigelow, *Med. Bot.*, ii. t. 27.

[2] In the United States the bark of *M. grandiflora* is often mixed with that of these species in commerce. It possesses the same properties. It has been analysed by Procter (*loc. cit.*): it contains an acid which gives a green precipitate with salts of iron; salts; volatile oil; a green resin; and the same crystallizable principle analogous to *liriodendrine*, as exists in *M. glauca* (Pereira, *op. cit.*, 676).

[3] It is their *Yu-lan*, or *Tsin-y*. Its emblematical flowers are so much prized that the tree is cultivated in pots, and forced so as to flower in winter.—Kæmpf., *Ic. Sel.*, t. 43.

[4] *M. fatiscens* L. C. Rich. ex DC., *Prodr.*, i. 82.—*Anona dodecapetala* Lamk.

[5] Sw., *Prodr.*, 87; *Fl. Ind. Occid.*, ii. 997.—*T. cærulea* Naum., ex Duch., *Rép.*, 177.

[6] A. Rich., *Elém. d'Hist. Nat. Méd.*, éd. 4, *Bot.*, ii. 454. The leaves and roots are prescribed as astringent and stomachic, and the leaf buds as antiscorbutic. The Indians make various domestic utensils of the wood; and a resin extracted from the plant is supposed to cure catarrh and leucorrhœa.

owe their peculiar delicate aroma. They have also been supposed to owe this to other species of *Magnolia*, and, as we shall see, to *Liriodendron Tulipifera*. *Aromadendron elegans* Bl., also belongs to this section. Blume[1] has told us of the great reputation this species enjoys in Java. It is a magnificent ornamental plant, whose wood is used for industrial purposes, and whose bark, flowers, fruit, and seeds are considered stomachic, carminative, and antispasmodic, and are prescribed against colic and other intestinal affections; the flowers have an exquisite perfume.

Manglietia glauca Bl.,[2] which is, as we have said, only a *Magnolia* with many-seeded carpels, has exactly the same bitter aromatic properties. Moreover, its wood, whitish and tough, is in Java supposed to prevent the decomposition of the dead, and is therefore used for the coffins of the wealthier classes. Its foliage and large yellowish flowers also make it a very ornamental plant.

Of the section *Michelia*, the species most used is *M. Champaca* L.,[3] a very fine tree, cultivated in all gardens in tropical Asia for the sake of its beautiful, sweet-scented flowers. The Hindoos have made it a sacred plant, and it plays a certain part in their civil and religious ceremonies. It was formerly used in Java to deck the temple and the nuptial chamber. The essential oil extracted from flowers, said to be as much esteemed as the essence of roses, affects the head, and may, we are told, induce giddiness. The wood is used in building and for domestic furniture. The bark is considered a tonic, stimulant, diaphoretic, diuretic, and febrifuge. The leaf-buds bear an odoriferous resin, much lauded in gonorrhœa. The leaves mixed with those of the aromatic *Amomeæ* are used for anti-arthritic powders; their decoction is used in lotions, in astringent gargles, and in baths for rheumatism. The fruit is used in abdominal complaints. The acrid bitter seeds are prescribed as a febrifuge. The root is a stimulant and emmenagogue. There is, in short, no part of this plant that is not considered useful.[4] Other species of the same group,

[1] *Fl. Jav. Magnoliac.*, 26, t. vii., viii.—H. Bn., *Dict. Encycl. des Sc. Médic.*, vi. 161.

[2] *Op. cit.*, 22, t. vi.

[3] *Spec.*, 756.—Lamk., *Illustr.*, t. 493.—DC., *Syst. Veg.*, i. 447; *Prodr.*, i. 79, n. 1.

[4] The smell of the fresh flowers is perfumed, but that of the dry corollas is disagreeable. The Malays wear wreaths of these flowers after bathing, and mix them with their cosmetics. It is said that the powdered bark has so stimulating an action, that not only is it an emmenagogue, but that an overdose may induce abortion. Gargles prepared from it are used in fœtid breath and asthenic anginas. The seeds are used in powder to rub in on the chest of fever patients, especially children (Endl., *Enchir.*, 429). Loureiro (*Fl. Cochinch.*, 1790, 347) also speaks of this plant as cultivated under the name of *Hoa sú nam*: "*Culta ob odorem floris cujus vehementia et constantia major est qùam suavitas*."

namely, *M. Dolstopa* BUCH.,[1] *montana* BL.,[2] *excelsa* WALL.,[3] *Kisopa* BUCH., *Tsjampaca* L., *longifolia* BL., &c.,[4] enjoy the same reputation, but are much less used.

The Tulip tree is, like the *Magnolia*, a very fine ornamental tree, often planted in our gardens and parks. Its wood is by no means useless. "White, and very light, it is well suited for turning; it is easily cut without being soft, woody without being stringy; it has a very agreeable colour, and takes a fine polish. In America it is used for making battens, planks, beams, tables, Venetian blinds,"[5] and other articles.[6] The savages hollow out the trunk into pirogues and canoes of a single piece. This tree is also prized for shipbuilding, as it is said that its wood is incorruptible, and that shipworms and sea weeds do not attach themselves to it. The bark of the stem is of lax fibrous texture, bitter, and aromatic,[7] considered a tonic antiperiodic in the United States; all the virtues of *Cinchona* have been attributed to it in the treatment of intermittent fever.[8] Gout, rheumatism, dysentery, phthisis, hysteria,[9] and certain diseases of the hair[10] have, it is said, been successfully treated by the bark. The root, vulgarly called *yellow wood* (Fr., *bois jaune*), has nearly the same properties. From it is prepared an agreeable liquor; and the Canadians use it to correct the bitterness of spruce-beer, and to give it a lemon flavour. It has been affirmed that the

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[1] This species is chiefly prized for its scented wood, used for building houses in Nepaul.

[2] The *Tsjampacca Gunnung*, or *Gelatrang* of the Japanese. Its aromatic bark has been compared to *Cascarilla* for its properties, but is less bitter.

[3] Or *Champa* of Nepaul, a very aromatic species.

[4] ROSENTH., *op. cit.*, 596.

[5] CUBIÈRES, *Mém. sur le Tulipier* (1803). This tree was introduced into France in 1732 by Admiral DE LA GALISSONNIÈRE. *Liriodendron acutilobum* MICHX., *obtusilobum* MICHX., *integrifolium* HORT., are only forms of *L. Tulipifera* L., or *procerum* SALISB.

[6] DUCH., *Répert.*, 177: "Shingles, coach panels, trunks . . . . wooden basins, horse-troughs, bars for fences."

[7] Its odour recalls that of the citron. According to TROMSDORFF & CARMINATI (*Ann. Chim.*, lxxx. 215), it contains tannin and bitter gummy principles. From it, says GUIBOURT (*Hist. Nat. des Drog. Simpl.*, éd. 4, iii. 678), has been extracted *liriodendrine*, a crystalline, non-alkaline, non-nitrogenized bitter substance that appears to bear some relations to *Salicine*. Dr. EMMET was the first to obtain this substance (*Journ. of Phil. Col. of Pharm*, iii. 5), inodorous at 40° F., fusible at 180°, and volatile at 290°, which he considers analogous to camphor. PEREIRA states (*op. cit.*, 677) that the abuse of Tulip-tree Bark may injure the alimentary canal. According to several authors, what has been termed *liriodendrine* is simply *piperine* (see ROSENTH., *op. cit.*, 597).

[8] MÉRAT & DE LENS (*Dict. Mat. Méd.*, iv. 130) relate the different cures observed by several celebrated physicians. The memoir of HILDENBRAND on the Tulip-tree is entitled "*Essai sur un nouveau succédané du Quinquina*" (*Ann. Chim.*, lxxvi. 201).

[9] BARTON says:—"In the whole Materia Medica there is no better cure for hysteria than Tulip-tree Bark, together with a little laudanum." BIGELOW (*Med. Bot.*, ii. t. 31) also points out the medicinal virtues of the Tulip-tree.

[10] Called *the bots* in *Virginia*.

peculiar perfume of the table liquors of Martinique is due to the presence of a liquid distilled from the bark of the Tulip tree.[1] The bruised leaves applied to the forehead are supposed to cure headache. The seeds form an aperient medicine.[2] Finally, the Tulip tree is one of the finest trees known; it is often more than 120 feet in height, and its trunk may be as large as twenty-one feet round at the base. It is not used in medicine in our country. "But," in the words of a classical writer[3] on this subject, "as it is naturalized there, and very common, new attempts might be made to verify its efficacy."

The *Schizandreæ* are very little used. The only species quoted is *Schizandra japonica*,[4] which, according to KÆMPFER[5] & THUNBERG,[6] develops a large quantity of mucilage in presence of a liquid. On chewing the bark, the mouth becomes full of gummy matter. The leaves infused in water give a sort of glue, used for gluing the paper made from *Broussonnetia papyrifera*. The Japanese women cover their hair with this mucilage, either before shaving it, or to remove the fatty cosmetics which they use to excess. The seeds are viscid, of a disagreeable taste. Several Asiatic species of *Sphærostema* are said to have edible berries.[7] Of the *Eupteleæ*, *Trochodendron aralioides* SIEB. & ZUCC. is alone cited as an odoriferous plant. "The aroma of the leaves and fruits," says SIEBOLD,[8] "would lead us to expect medicinal virtues."

No product of this family is more used than the *Star-anise* [*Fr. Anis étoilé*, *Badiane*,][9] the name given to the fruit of various species

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[1] The opinion of CUBIÈRES (*loc. cit.*, 6). Others think that the trees used for this purpose are *Talaumas*.

[2] *Anc. Journ. de Méd.*, lxx. 350.

[3] A. RICH., *Elém. d'Hist. Nat. Médic.*, éd. 4, *Bot.*, ii. 453.

[4] *Kadsura japonica* DUN., *Monogr. Anonac.*, 25, 28.

[5] *Amœn. Exot.*, 476, t. 477.

[6] *Fl. Jap.*, 237.

[7] ROSENTH., *op. cit.*, 594.

[8] "Fama Kuruma, *i.e.*, *rota montana* (SIEB., *loc. cit.*, 86) *arbor* Illicio & Tasmanniæ *affinis* . . . ., *foliorum et fructuum qualitate aromatica affinitatem confirmante*." (ENDL., *Enchir.*, 430.)

[9] The best collection of information, historical and bibliographical, relating to these products will be found in the work we have recently published under the title, "*Recherches sur l'Origine Botanique des Badianes ou Anis Etoilés*" (*Adansonia*, viii. 1). See also KÆMPFER, *Amœn. Exot.*, 880, t. 881.—CLUSIUS, *Hist.*, ii. 202.—BAUHIN, *Pin.*, 159.—L., *Gen.*, 611; *Spec.*, 664; *Mat. Med.*, 510.—THUNB., *Voyag.*, iv. 77.—ADANS., *Fam.*, ii. 364.—JUSS., *Gen.*, 280.—GÆRTN., *Fruct.*, i. 368, t. 69, f. 6.—ELLIS, *Act. Angl.* (1770), 524, t. 12.—BUCH., *Pl. Nouv.* (1779), 30, t. xxviii.—REGNAULT, *Bot. Tab.*, 396.—LOUR., *Fl. Cochinch.*, ed. Ulyssip. (1790), 353.—LAMK., *Dict.*, i. 351; *Illustr.*, t. 493, f. 2.—POIR., *Suppl.*, i. 558.—VENT., *Jard. Cels.*, t. 22.—MICHX., *Fl. Bor.-Amer.*, i. 326.—MER. & DE LENS, *Dict. Mat. Méd.*, i. 592.—DUCH., *Repert.*, 176.—NEES, *Pl. Méd.*, iii. t. 371.—MIERS, *Contrib.*, i. 142.—SIEB. & ZUCC., *Fl. Jap.*, i. 5, t. 1.—A. RICH., *Elém. d'Hist. Nat. Med.*, ed. 4, ii. 456.—GUIBOURT, *Drog. Simpl.*, éd. 4, iii. 649, f. 430.—PEREIRA, *Elem. Mat. Med.*, ed. 4, ii. p. ii. 677.—LINDL., *Flor. Med.*, 25.—ROSENTH., *Syn. Pl. Diaphor.*, 598.—RÉVEIL, *Fl. Méd. du* xix^e *Siècle*, i. 143.—MIQ., *Ann. Mus. Lugd.-Bat.*, ii. 257.—H. BN., *Dict. Encycl. des Sc., Médic.*, viii. 81.

of *Illicium*; one from Asia, *I. anisatum* L., and two from America, *I. parviflorum* MICHX., and *floridanum* ELL. At least, it is said that in America these two last species are used as aromatic plants, the leaves in stimulating stomachic infusions, and the fruits for the same purposes as the Chinese Star-anise—that is, *I. anisatum* L., the *Pa-co* of the Chinese. It is further asserted that these fruits are mixed with those of the true Star-anise, or substituted for them in European commerce; but this assertion is hardly confirmed by examining the fruits sold in this country, which generally possess eight branches or carpels; while those of the American species have usually more. This is no proof that the substitution would be at all injurious. The three plants above mentioned have fruits of very agreeable perfume, and are rich in a stimulating, stomachic, digestive, carminative essential oil. We also find these properties in the powder and infusion of Star-anise, as well as in the alcoholic liqueurs prepared from it, especially the anise cordials (Fr. *anisettes*) of Bordeaux and Holland. The Orientals have very long used these *Zinghi* seeds, as they call them, as digestives, whether alone, or mixed with tea, coffee, ginseng, sherbet, &c. We, with some other contemporary writers, believe that it is the same species, introduced into Japan and cultivated, which has there been called "*Badiane sacrée*" (*I. religiosum* SIEB. & ZUCC.) There its fruits become sickly and nauseous to the taste; they are even considered venomous, though it is admitted that they may be in certain cases used as antidotes. But the aroma exists in the leaves and branches, which are used in perfumed infusions, and which, planted in cemeteries and around temples, under the name of *Skimi*, or *Skomo*, are used to deck tombs and sanctuaries; while the powdered fruit, burnt slowly in a sort of tube, serves to measure time like a sand-glass. The bark is also very odoriferous when burnt; it is therefore used in the temples in China and Japan, under the name of *Lavola bark*.[1]

The various species of *Drimys* enjoy similar properties, chiefly residing in their bark. The most celebrated is the *Winter bark*, or *Magellan Canella*,[2] which JOHN WINTER was the first to make

[1] The Star-anise from the Philippines has been attributed to *I. Sanki* PERR., which is unknown to us, and is perhaps only a form of *I. anisatum* L. (see ROSENTH., *op. cit.*, 509).

[2] *Cortex Winteranus verus, Cinnamomum magellanicum, Costus âcre* of the druggist.—GUIB., *Hist. Nat. des Drog. Simpl.*, éd. 4, iii. 679.—A. RICH., *Elém. d'Hist. Nat. Méd.*, ed. 4, *Bot.*, ii. 454.—PEREIRA, *Elem. Mat. Med.* ed. 4, ii. pars ii. 673.—LINDL., *Fl. Med.*, 26.—RÉVEIL, *Bot. Méd. du xix^e Siècle*, i. 178.—ROSENTH., *op. cit.*, 597.

known in Europe in 1579, having discovered it in the neighbourhood of Magellan's Straits, in Sir F. DRAKE's circumnavigation of the world. The use of this bark during the passage had, it appears, cured or preserved the crew from scurvy. CLUSIUS gave it the name of *Winter bark*, and described it[1] as aromatic, acrid, burning, and pungent.[2] It is probably the same plant, or one of its varieties, that FORSTER names *Drimys Winteri*, and of which SOLANDER & MURRAY made their *Winterania*, or *Wintera aromatica*. *Drimys chilensis* DC. (the *Canelo* of Chili), *punctata* LAMK., and *granatensis* L. FIL., which are for many authors only forms of *D. Winteri*, all have aromatic, pungent, very stimulating barks, that might be employed like the true *Winter bark*,[3] now-a-days extremely rare, so that the bark of species of *Canella* and *Cinnamodendron* is almost always substituted for it. As to the acrid, pungent, astringent, aromatic bark from Mexico, called *Chachaca*, or *Palo piquante*, if produced, as conjectured, by *D. mexicana* DC., it only owes whatever difference it may have in taste or aroma from *D. granatensis* to the different conditions under which it is developed, for the two plants are identical. All the American and Oceanian species of *Drimys* indifferently might, no doubt, serve the same ends. The Australian and Tasmanian species, which constitute the section *Tasmannia*, have very similar properties.[4]

All the *Canelleæ* are very aromatic, pungent, stimulating plants. These properties have been long recognised in the type of this group, *Canella alba*, or *Winterania Canella*, which produces the *Canella Alba Bark* of druggists, often substituted for *Winter Bark*,[5] from which it is easily enough distinguished by its agreeable scent of cloves and nutmeg, by its perfumed, pungent taste, and by its characteristic

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[1] *Exotic.*, lib. iv. cap. i. 75, fig.

[2] Winter Bark, as analysed by E. HENRY (*Journ. Pharm.*, v. 489), contains volatile oil (*oleum corticis Winteri*), a nearly inodorous very acrid reddish-brown resin, a colouring matter, tannin, chlorate, sulphate, and acetate of potass, oxalate of lime and oxide of iron.

[3] *D. granatensis* is called in New Granada *Arbol de Agi*, and in Brazil *Palo de Malambo*, *Canela de Paramo*, *Casca d'Anta*, or *Tapir's Bark*, because it is alleged that this animal eats the plant to cure its diseases, and that from the animal man learned to know its virtues. The Brazilians often employ this aromatic, very stimulating bark (A. S. H., *Pl. Us. Brasil*, t. xxvi.–xxviii.).

[4] *D. axillaris* FORST., from New Zealand, is also aromatic, stimulant, and stomachic. The fruits of *D. lanceolata*, or *Tasmannia aromatica* R. BR., are powdered by the colonists and used as a condiment instead of pepper.

[5] Accordingly it is sometimes called *False Winter Bark* (*cortex Winteranus spurius*), and also *Cannelle poivrée*, or *bâtard Costus doux*. It is not only a stimulating tonic drug, but it is also used as a condiment in the French colonies of the Antilles. The fruits enter into perfumed preserves, and the bark is candied. A sweet substance extracted from it has been called *cannelline* (ENDL., *Enchir.*, 536).

form and colour. It comes from the Antilles and the neighbouring countries of South America in long, rather large rolls of a pale orange yellow colour, somewhat ash-coloured outside, and of a uniform whitish tint within; it is thin, brittle, and rich in volatile oil. It is still pretty often used in medicine.[1] The genus *Cinnamodendron* furnishes two practically useful barks: 1st, that of *C. axillare* ENDL. (*Canella axillaris*, MART.), called in Brazil *Paratudo aromatico*, which has in this country enjoyed a considerable reputation in the treatment of a large number of diseases.[2] It is thick, of a peppery, fatty odour, and an extremely bitter, acrid, burning taste. 2ndly, that of *C. corticosum* MIERS. This is very thick and solid, too; smooth, yellowish brown, pale, and somewhat pinky on the outside, of a more or less blackish tint within; of aromatic odour and very acrid pungent taste. It also comes over from the Antilles and the neighbouring countries of the mainland.[3] The genus from Madagascar belonging to the same group, that we have termed *Cinnamosma*, must have properties very similar to the preceding plants. Its bark, too, is pungent and stimulant. Its scent is aromatic, but less peppery, and less like nutmeg, coming nearer cinnamon and citron. We have pointed out[4] how it may some day be used in therapeutics.

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[1] It enters into the "*vin diurétique amer de la Charité*"). E. HENRY (*Journ. de Pharmac.*, v. 482) gives its analysis compared with that of *Winter bark* (GUIBOURT, *Hist. Nat. des Drog. Simpl.*, éd. 4, iii. 565).

[2] "The name of *Paratudo* or *Casca per tudo*, which means *fit for everything*, has been given in Brazil to several substances to which great medical virtues are ascribed." (GUIBOURT, *op. cit.*, iii. 567.) Its taste is so strong that "pepper," says the same author, "and *feverfew* do not come near it."

[3] It is this same bark that GUIBOURT (*op. cit.*, iii. 682) describes as *Commercial Winter Bark* (*écorce de Winter du commerce*), and to which he also refers *E. caryocostine* of LÉMERY. It is nearly a third of an inch in thickness. Its odour is like pepper and basil mixed. Its taste is sometimes very strong and quite unbearable. It often enters into the composition of the "*vin diurétique amer de la Charité*" instead of the true *Winter bark*, which is hardly sold now-a-days.

[4] *Adansonia*, vii. 3.

GENERA.

I. MAGNOLIEÆ.

1. **Magnolia** L.—Flowers hermaphrodite; receptacle conoidal more or less elongated. Sepals 2–4, petals 6–∞, in 2–∞ whorls; præfloration imbricate. Stamens and carpels ∞ arranged in a spiral; bare part of gynophore between androceum and gynæceum more or less elongate very short, or 0. Stamens free, anthers 2-celled adnate dehiscing by introrse or lateral clefts. Carpels capitate or spicate; ovary 1-celled; placenta ventral 2–∞-ovulate; ovules either descending, micropyle exterior superior, or sub-horizontal, micropyle exterior lateral; style of variable form grooved longitudinally and internally; apex papillose stigmatiferous. Fruit multiple; carpels subsucculent, finally dry, either capitate on a rather short receptacle, or finally arranged like a spike or cone on a more or less elongated receptacle, all fertile, or a fair number sterile and abortive; indehiscent and persistent until putrefaction, dehiscing dorsally, or falling off by the base separately or in irregular masses. Seeds drupe-like, finally pendulous from a filiform funicle; inner coat woody; albumen copious fleshy; embryo minute subapical.—Trees or shrubs; leaves alternate stipulate evergreen or deciduous; stipules supra-axillary, in turn shutting in the leaves in vernation, and finally disclosing them, caducous; flowers terminal or axillary (*N. tropical America, tropical, subtropical and eastern Asia*). See p. 129.

2. **Liriodendron** L.—Perianth 9-partite, inserted on an oblong receptacle. Leaves 3 outer sepaloid reflexed; 6 inner petaloid connivent in 2 whorls, imbricate. Stamens and carpels ∞, inserted along one continuous spiral. Anthers linear adnate extrorse. Carpels spicate; ovaries 2-ovulate; ovules obliquely descending; style compressed leafy, apex stigmatiferous. Fruit multiple strobiliform; carpels indehiscent 1 or 2-seeded, samaroid through the styles persisting into membranous-woody imbricated wings, samaras finally deciduous. Seeds pendulous; albumen fleshy copious; embryo superior minute.—A tree; leaves alternate sinuately 4-lobed, truncate

minutely apiculate, vernation reclinate; stipules lateral valvate; flowers solitary terminal (*North America*). See p. 139.

II. SCHIZANDREÆ.

3. **Schizandra** Michx.—Flowers unisexual.—Male flower. Perianth ∞-partite; leaves dissimilar, gradually changing from the outermost very small to the inner ones larger petaloid, inserted in a spiral, imbricate, caducous. Stamens ∞ in a spiral; filaments free or monadelphous only at the very base, linear or variably thickened and dilated at the apex; anther cells introrse or lateral, more rarely subextrorse, adnate, parallel or more or less diverging and oblique, dehiscing longitudinally.—Female flower. Perianth of male flower. Carpels ∞, free in a spiral; ovary 2-, more rarely 3-ovulate; ovules pendulous, micropyle extrorse superior; inner angle of ovary produced into a style winged and decurrent at the base; apex dilated stigmatiferous. Fruit multiple; common receptacle finally shortly capitate (*Kadsura*) or much elongated, spike-like, (*Euschizandra*); carpels baccate, pulpy within, 1, 2-seeded. Seeds reniform albuminous; embryo minute subapical.—Shrubs, usually climbing or sarmentose; leaves alternate exstipulate, often with pellucid dots. Flowers axillary, solitary, or few cymose (*North America, tropical and eastern Asia*). See p. 141.

III. ILLICIEÆ.

4. **Illicium** L.—Perianth ∞-merous, leaves imbricate in a spiral of ∞ turns, all subsimilar or the outermost broader and shorter discoloured. Stamens ∞, pseudo-verticillate; filaments rather thick strapshaped, or (*Cymbostemon*) much thickened at apex, subcymbiform; anthers introrse 2-celled. Carpels ∞ free pseudo-verticillate around apex of receptacle, tapering upwards into a recurved style stigmatiferous internally at apex; ovule solitary ascending inserted at base of ventral angle; micropyle extrorse inferior. Fruit 6–∞-follicular; follicles pseudo-verticillate thick woody dehiscing by inner edge, 1-seeded. Seed glabrous.—Small evergreen trees or shrubs; leaves alternate exstipulate, with pellucid dots; flowers terminal (*Cymbostemon*) or axillary near the

apex of a twig (*Euillicium*) solitary or few cymose (*North America, eastern Asia*). See p. 146.

5. **Drimys** Forst.—Flowers hermaphrodite or polygamous. Calyx gamophyllous sacciform or cupuliform membranous valvate, at anthesis irregularly cleft or breaking open. Petals 2–∞ spirally imbricated in ∞ whorls. Stamens ∞ in a spiral on a cylindrical receptacle; filaments free rather thick; anther-cells extrorse parallel or diverging dehiscing longitudinally. Carpels 1–∞ (usually few) pseudo-verticillate free, ovaries with ∞ oblique or transverse ovules in two vertical rows; style short, apex dilated stigmatiferous. Fruit simple or more frequently multiple; carpels indehiscent many-seeded.—Evergreen trees or shrubs; leaves alternate exstipulate with pellucid dots. Flowers cymose, either axillary or lateral to branches a year old or older (*Eudrimys*), or in the axils of leaves or bracts on younger twigs; cymes simple or branched, more rarely 1-flowered (*South America, New Zealand, Australia, Borneo*). See p. 151.

6. **Zygogynum** H. Bn.—Flowers hermaphrodite; peduncle dilated around base of receptacle into a short orbicular subentire cupule (calyx ?). Petals (?) few unequal concave thick imbricate deciduous. Stamens ∞ (of *Drimys*). Carpels ∞ arranged in a spiral, cohering into a single ∞-celled ovary; ovaries ∞-ovulate; ovules oblique in two vertical rows on inner angle; styles short distinct, apex capitate stigmatiferous. Fruit syncarpous. . . .—Small evergreen tree; leaves alternate exstipulate dotted; flowers solitary terminal; peduncle thick articulated at base (*New-Caledonia*). See p. 156.

IV. EUPTELEEÆ.

7. **Euptelea** Sieb. & Zucc. — Flowers polygamous. Receptacle somewhat concave. Perianth 0. Stamens ∞ slightly perigynous. Filaments free, shortly filiform, anthers basifixed, apiculate; cells adnate, lateral dehiscing longitudinally. Carpels ∞ stipitate, inserted in a nearly simple verticil in the bottom of the receptacle; ovary 1-celled; ovules 1—4 inserted on the ventral angle, obliquely descending, micropyle extrorse superior, or horizontal or sub-

ascending; stigma sessile linear extending downwards and inwards from apex of the ovary to insertion of the ovules. Fruit multiple; carpels stipitate samaroid with membranous wings indehiscent 1—4 seeded. Seed albuminous, embryo minutely subapical.—Trees; buds scaly: leaves alternate deciduous exstipulate; flowers fascicled emerging from scaly buds (*East Indies, Japan*). See p. 157.

8. **Trochodendron** Sieb. & Zucc.—Flowers hermaphrodite or polygamous. Receptacle concave, cup-shaped. Perianth 0. Stamens ∞ perigynous, filaments free filiform, anthers truncate basifixed; cells subextrorse dehiscing longitudinally. Carpels ∞ (not more than 8), inserted in a nearly simple verticil on lower part of concavity of the receptacle, free internally; ovary 1-celled; ovules ∞ anatropous inserted in 2 rows on the ventral angle; styles short grooved internally, stigmatiferous towards the apex, finally recurved. Fruit multiple; carpels subdrupaceous, finally dry, adnate on the outside to the concave receptacle, dehiscing on the inside (as follicles?) longitudinally. Seeds pendulous, albuminous; embryo minute apical.—Trees; buds scaly, leaves alternate evergreen exstipulate; flowers in racemes emerging from scaly buds (*Japan*). See p. 158.

V. CANELLEÆ.

9. **Canella** P. Br.—Flower hermaphrodite, regular. Calyx of 3 imbricate leaves. Corolla of 5 free deciduous petals; æstivation imbricate or contorted. Stamens not more than 20; filaments monadelphous cohering into a tube. Anthers 1-celled linear adnate to the outside of the tube, dehiscing longitudinally, connectives united above the anthers into a short tube crenate at the top. Ovary superior unilocular; placentas 2 or 3, parietal pauciovulate; ovules mostly 2 or 3 on each placenta, pendulous, reniform arcuate; micropyle introrse superior. Style short thick; at the apex shortly 2–3-lobed stigmatose. Fruit baccate, slightly pulpy within 1–6-seeded. Seeds pendulous albumen copious, fleshy-oleaginous; embryo eccentric arcuate: radicle short, superior; cotyledons oblong.—Small glabrous trees; leaves alternate exstipulate, with pellucid dots; flowers numerous on branched subcorymbose terminal cymes (*Tropical America*). See p. 159.

10. **Cinnamodendron** ENDL.—Flowers of *Canella;* corolla 4- or 5-merous, within provided at the base with short thin nearly equal petaloid scales of variable number (most usually 4 or 5). Stamens 15–20 (of *Canella*). Ovary 1-celled; placentas 3–5, ∞-ovulate; style short thick; stigma capitate 3–5-lobed. Ovules berries and seeds of *Canella;* pulp copious around the seeds.—Small trees; leaves alternate exstipulate, with pellucid dots; cymes few-flowered, axillary, or lateral to the year old branches (*Tropical America*). See p. 162.

11. **Cinnamosma** H. BN.—Flowers of *Canella;* petals 5, quincuncially imbricated, or 6, imbricated in 2 whorls (the inner 3 alternating with the outer ones), united at the base into a long gamopetalous tubular corolla; lobes of limb patent, finally reflexed. Stamens not more than 15 (of *Canella*) connectives produced above the cells into a short tube, straight and truncate at apex. Ovary 1-celled; placentas 3- or 4 pauci (often 2)-ovulate. Style short conoidal. Ovules and berry of *Cinnamodendron.*—A shrub; leaves alternate, exstipulate with pellucid dots; flowers solitary axillary, provided with a few imbricate bracts like the sepals, but shorter (*Madagascar*). See p. 162.

IV. ANONACEÆ.

I. ANONA SERIES.

A. Uvarieæ.—There is but one of the *Anonaceæ* that can be thoroughly studied in the open air in France. It has been referred

Uvaria (Asimina) triloba.
Fig. 220.
Floriferous branch.

to the genus *Asimina*,[1] under the name of *A. triloba*.[2] It is cultivated in our gardens. The flowers, which expand in spring, a little before the

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[1] Adans., *Fam. des Pl.*, ii. (1763), 365.—Dun., *Mon. Anonac.* (1817), 83.—DC., *Prodr.*, i. 87.—Spach, *Suit. à Buffon*, vii. 526.—Walp., *Rep.*, i. 79.—A. Gray, *Gen. Ill.*, i. 67, t. 25, 26.—B. H., *Gen.*, 24, n. 14.—H. Bn., in *Adansonia*, vi. 253; vii. 377; viii. 301.—*Orchidocarpum* Michx., *Fl. Bor.-Amer.*, i. 329.

[2] Dun., *op. cit.*, 83.—DC., *loc. cit.*, n. 2.—*A.*

leaves, are regular and hermaphrodite; the nearly conical base of the convex receptacle supports a triple perianth, above which it swells into a sort of dome, covered with stamens, and bearing the carpels on its slightly depressed apex (fig. 222). The calyx consists

Fig. 221.
Diagram.

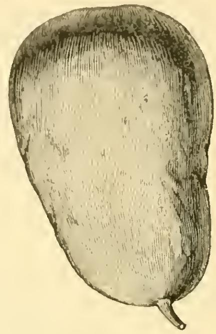


Fig. 225.
Berry.

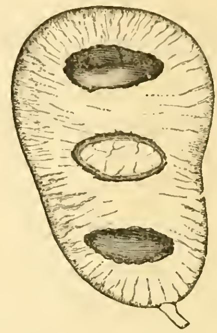
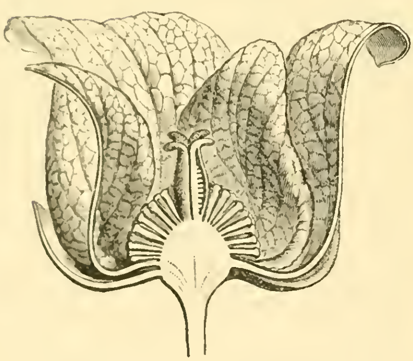
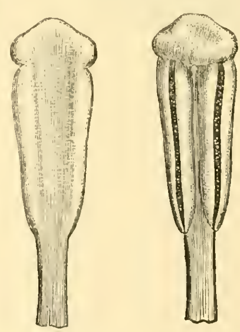
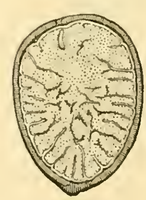


Fig. 226.
Long. section of berry.

Fig. 227.
Seed.







Uvaria (Asimina) triloba.

Fig. 222.
Long. section of flower.

Figs. 223, 224.
Stamens, front and back view ($\frac{8}{1}$).

Fig. 228.
Long. section of seed.

of three[1] free sepals, of which two are anterior, valvate or sometimes slightly imbricate in the bud. The corolla is double, each whorl consisting of three free petals. The outer ones are alternisepalous,

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campaniflora Spach, *op. cit.*, 528. — *Anona triloba* L., *Spec.*, 758.—*Porcelia triloba* Pers., *Enchir.*, ii. 95. — *Orchidocarpum arietinum* Michx., *loc. cit.*—*Uvaria triloba* Torr. & A. Gray, *Fl. of N.-Amer.*, i. (1838-40), 45.

[1] The flowers are normally trimerous, but we have observed some flowers accidentally dimerous, and others with three interior and only two exterior petals (*Adansonia*, vii. 377).

imbricated in the bud, and finally valvate. The inner petals are smaller, and alternate with these, and like them are imbricated when young. When the flower is fully expanded they do not even touch on a level with their contracted bases.[1] The stamens, very numerous and spirally arranged, are of the shape of an elongated wedge inserted into the receptacle by its apex, and swelling above into a rounded head (figs. 223, 224). The anther consists of two narrow cells applied vertically along this wedge, close to its edges, but nearer the outer face. These extrorse cells dehisce longitudinally.[2] The gynæceum consists either of six free carpels superposed to the petals, or more frequently of some other number.[3] Each consists of a unilocular ovary, bearing a short recurved style, covered with stigmatic papillæ.[4] Within the ovary we find a parietal placenta divided by a longitudinal groove[5] into two vertical lobes, each of which supports a row of anatropous ovules,[6] with the raphes looking towards those of the other row. The fruits

[1] These petals present several peculiarities which we have pointed out in a note entitled *Observations sur des Petales à Structure Anormale,* (*Adansonia,* vi. 253). The chief are the fleshy glandular projections of the inner face, secreting a nectar which retains the pollen that falls into the cup of the corolla; the fact that these papillæ contain tracheæ which proceed from the fibrovascular bundles of the limb, forming short masses, ending in spirally thickened cells placed almost end to end. When young the petals are quite green; they gradually acquire a brownish tint, which grows deeper day by day, finally becoming a very dark wine purple—a colour often found in the corollas of *Anonaceæ.* It may be replaced by yellow or orange, or even by brilliant red, rarely, as in *U.* (*Sapranthus*) *nicaraguensis,* by violet, or even nearly blue tints.

[2] The stamens, often formed on this type in the order *Anonaceæ,* and, especially in the genus *Uvaria,* are of the kind which BENTHAM & HOOKER term "*Stamina Uvariearum.*" The sort of inverted truncated pyramid formed by them varies greatly in length at different ages, as does that part of the stamen below the cells, which is called the filament, though not really distinct from the connective. The base becomes early detached, and they fall into the cup of the corolla, but still remain some time attached to the receptacle by bundles of tracheæ, which gradually elongate like those supporting the seeds of *Magnolia.* The pollen in each cell forms like a long necklace of two or three rows of white grains united by the very thin débris of the mother-cells. Each grain consists of from two to four (usually three) ellipsoidal granules. These are glabrous, with a minutely areolate outer membrane, and are the simple grains. When three of these cohere they occupy the vertices of an equilateral triangle; when four, they form a regular or irregular tetrahedron, as in *Drimys.* On moistening the pollen the depressions separating the elementary granules tend to become obliterated.

[3] There are often only three, or sometimes even two, carpels.

[4] The stigmatiferous part is obovate, white, and very soft. The rounded apex is somewhat reflexed and bathed in a viscid liquid at the time of impregnation. Later on the whole stylar portion of the ovary blackens and separates by its now very contracted base, from the apex of the ovary, which remains deep green, and is entirely covered with small white hairs.

[5] This groove is as well marked without as within the carpellary leaf, along the whole length of the internal angle of the ovary, and is prolonged on to the style, its thickened and everted borders forming the stigmatic surface. This also extends a little without the apex of the style.

[6] Their number varies greatly. There may be as many as fifteen in each row. They are incompletely anatropous. They have two coats, of which the inner is very remarkable for the long tube which it sends through the exostome; the wall of the endostomic orifice is swollen into a ring at the end of this funnel.

are berries (figs. 225, 226); each ovary becomes an indehiscent stipitate mass, the thick pericarp projecting inwards to form short septa between the seeds, and dividing it into a certain number of one seeded compartments. The seed contains ruminated fleshy albumen, near the apex of which is the small embryo (fig. 228). On this side is a but little marked arillary thickening, beside the micropyle and the umbilical scar[1] (fig. 227).

A. triloba is a shrub with alternate simple exstipulate leaves. Its flowers, solitary, and usually pedunculate, arise from the axils of some of the lower leaves of the last year's branches.[2] *A. parviflora* Dun,[3] *grandiflora* Dun,[4] and *pygmæa* Dun,[5] have a similar organization, and are natives of the same regions, *i.e.* the most southern part of North America. Accordingly, all authors are agreed in retaining them in the same genus as *A. triloba;* so rightly refusing to take into account the few unimportant differences presented by some of these species, whether in the form and relative size of the pieces of the two corollas,[6] or in the mode of æstivation, which becomes quite valvate, for the inner petals[7] when they are short have thick edges.

Under the name of *Fitzalania*[8] has been described an Australian

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[1] M. T. Caruel (*Studi sulla polpa che involve i semi*, &c., in *Ann. del Mus. di Firenze*, 1864) has shown (9, t. i., figs. 1-7) that in the fruit of *A. triloba* the pericarp surrounds the seeds with a sort of pulpy fleshy sac, and thinks this the organ considered the aril of *Asimina* by Asa Gray (*Gen. Fl. N.-Amer.*, i. 65). Nothing can be more correct, and this sac simply represents a part of the pericarp applied to the seed, so as to come off with it. But besides this there is at the apex of the seed, around the micropyle and by the hilum, an ill-defined thickening of the outer seed coat, which represents a rudimentary aril; this in certain *Anonaceæ* is much more developed, forming a more or less projecting pad, or even a whitish fleshy body with two lateral auricles or wings that are sometimes very prominent. (See *Adansonia*, viii. 333.)

[2] The recurved peduncle is covered with the same brown hairs that are found abundantly on the outer surface of the calyx, and also on the bracts that enveloped the flower when young and during the winter. These bracts, of variable number (there are sometimes only two), separate from the peduncle and fall off when the flower expands. The flowers preferably occupy the axils of the first two or three leaves of the last year's branch. As early as June we can recognise what axils will be occupied by flower buds, so that nearly a year before the flowers come out we can predict whether they will be abundant in the next spring.

[3] *Uvaria parviflora* Torr. & A. Gray, *loc. cit.*, n. 2.

[4] *Orchidocarpum grandiflorum* Michx., *loc. cit.*—*Uvario obovata* Torr. & A. Gray, n. 3.

[5] *Anona pygmæa* Bartr.—*Uvaria pygmæa* Torr. & A. Gray, n. 4.

[6] See *Adansonia*, viii. 302. In the flowers of *U. parviflora* Torr. & Gr. the inner petals are smaller than the outer ones, but of similar form. In *U. triloba* there is a time when both sets are of nearly equal length. The inner petals of *U. obovata* are by far the shorter, and in every respect like those of several *Monodoras*. The base tapers to a claw, and the dilated apex is almost the shape of an arrowhead. These three petals converge to form a sort of vault with three pillars. In *U. pygmæa* the form and arrangement of the inner petals is the same; but the difference of size between them and the outer ones is less decided.

[7] The inner petals of *U. pygmæa* and *obovata* only touch by their thickened borders in this dilated almost sagittate part, which exactly recalls the conformation of the pieces of the inner corolla in several *Monodoras*.

[8] F. Muell., *Fragm. Phyt. Austral.*, iv. 33.

Anonad, with exactly the flowers and fruit of *A. triloba*, except that its petals present a slight difference, the inner ones alone being imbricate, while the outer ones are but very slightly so, finally becoming valvate. Its vegetative organs are the same, and the flowers are also solitary axillary. There was not the least ground for distinguishing this genus from *Asimina;* it has not been retained. It has been included in the great Linnæan genus *Uvaria*,[1] to which it is hence impossible to refuse to admit *Asimina.* This admission has been a matter of history for the last thirty years.[2]

Before this time the genus *Uvaria*[3] was only allowed to contain plants from tropical Asia and Africa.[4] If we inquire what characters are common to these *Uvarias* properly so called, we find that their flowers present a triple perianth and an indefinite number of carpels and stamens on a convex receptacle. The calyx is composed of three sepals, nearly free, or more commonly united for a very variable extent, sometimes even joined into an entire, or scarcely dentate sac, valvate or more or less imbricate when young. The petals, rounded, oval or oblong, often all equal or nearly so, are imbricated in the bud. The stamens consist of a narrow elongated obpyramidal connective, with two linear adnate extrorse anther cells, dehiscing longitudinally. Above these the connective is prolonged into either a swollen truncated head, or a blade of variable size and form, sometimes leafy and oblong or lanceolate. The carpels, inserted near the rounded or flattened apex of the receptacle, are formed of an ovary with indefinite anatropous ovules inserted in two vertical rows, back to back, along the inner angle. The usually short style, dilated into a stigmatiferous head at its apex, surmounts the inner angle of the ovary, the whole length of which is traversed by a longitudinal groove. The fruit is multiple, composed of a variable number of many- or one-seeded berries, with a somewhat contracted base, almost

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[1] F. MUELL., *op. cit.*, iii. 1.—BENTH., *Fl. Austr.*, i. 51.—B. H., *Gen.*, 955.—H. BN., in *Adansonia*, viii. 303.

[2] TORR. & A. GRAY, *op. cit.* (See p. 187, note 2.)

[3] L., *Gen.*, n. 692.—JUSS., *Gen.*, 284.—DC., *Syst. Veg.*, i. 481; *Prodr.*, i. 88.—SPACH, *Suit. à Buffon*, vii. 519.—ENDL., *Gen.*, n. 4717.—B. H., *Gen.*, 23, 955, n. 3.—H. BN., *Adansonia*, viii. 335.—*Krokeria* NECK., *Elem.*, n. 1097.

[4] BLUME was the first to reduce to the Old World a species of this genus, which, according to his predecessors, included a large number of Anonads from all countries, that are now referred to seven or eight different genera. But he had at first united in this one genus both *Uvaria* and *Unona*, which he only distinguished from one another by the form of the fruit (*Fl. Jav. Anonac.*, 11, 51).

always sessile or nearly so, more rarely stipitate (fig. 229). They vary greatly in form, being ovoidal, obovoidal, cylindroidal or club-shaped. The seeds, which contain a ruminated albumen and a small embryo near the apex, are separated from one another by false transverse dissepiments, to which answer circular external contractions, usually but little marked and sometimes quite wanting. The *Uvarias* are shrubs, often creeping and climbing. Their alternate leaves are usually covered with a more or less abundant down, as are the young branches, peduncles, calyces, receptacles, and fruits.[1] The flowers are axillary or terminal, often leaf-opposed in the latter case, sometimes solitary, sometimes united into few-flowered cymes. About two-score species are admitted,[2] of which the number will probably have to be reduced.

Uvaria rufa.
FIG. 229.
Berry.

In the flowers of *U. sphenocarpa*[3] (Ceylon), the petals are united for a certain height into a corolla, which falls off in a single piece. This character, which in certain other groups is considered of capital importance, can have none in the genus *Uvaria*, for in it we find every intermediate stage between the gamopetalous *U. sphenocarpa*, the species where the union of the petals is scarcely indicated, and those which are completely polypetalous.

Even besides *Asimina* there are other *Uvarias* of American origin; viz., the *Porcelias*[4] of Peru, which possess all the essential characters of this genus, the sexual organs and perianth being exactly the same. The petals of both corollas are imbricated, especially those of the inner one.[5] The carpels are indefinite, and occupy the centre of a convex receptacle. Each contains an indefinite number of

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[1] The hairs of which it consists are often stellate, and are whitish, tawny, or rust-coloured.

[2] See p. 195, notes 4–6.

[3] HOOK. & THOMS., *Fl. Ind.*, i. 99, n. 7.—THWAIT., *Enum. Pl. Zeyl.*, 6, n. 3.—WALP., *Ann.*, iv. 46. We may make a section of this genus under the title of *Sy[illegible]raria* to include those species in which the corolla thus falls off in a single piece; but we must recognise the fact that the exact limits between this section and those containing quite polypetalous species are often very artificial; a proof of the little value of the genera *Hexalobus*, &c.

[4] RUIZ & PAV., *Prodr. Fl. Peruv. et Chil.*, 84, t. 16; *Syst.*, i. 144.—DC., *Prodr.*, i. 88.—DUN., *Mon.*, 85.—ENDL., *Gen.*, n. 4717. a.—B. H., *Gen.*, 23, 956, n. 4.—H. BN., *Adansonia*, viii. 303.

[5] They grow for a long time, even after the expansion of the flower, and their bases become gradually contracted, especially in the inner petals.

ovules, and becomes a shortly stipitate berry,[1] quite analogous to that of an *Asimina*. The *Uvarias* of this section are shrubs with alternate leaves and axillary flowers, solitary or united into few-flowered cymes. Their peduncles are pretty long and slender, often with a bract about half way up. We may add that several *Porcelia* flowers that we have dissected were becoming male by the more or less complete abortion of the gynæceum. When this disappears entirely we find only stamens, inserted up to the very centre of the receptacle, which is even less convex than in the hermaphrodite flowers. We may then define *Porcelia* as consisting of American species[2] of *Uvaria* with hermaphrodite or polygamous flowers.

Nor is there any great generic difference between the *Uvarias* and *Sapranthus nicaraguensis*,[3] a plant whose enormous flower[4] possesses a trimerous imbricate calyx, and six large, equal, flattened, membranous petals, forming a double imbricate corolla. The carpels and stamens are indefinite, and formed exactly as in *Asimina* and *Porcelia ;* so too are the fruits. This section of the genus *Uvaria* is as yet only represented by one small tree, whose leaves are coated with a velvety down, like the twigs and peduncles. The solitary, leaf-opposed flower[5] terminates a peduncle which bears a leafy bract, and is distinguished by its fœtid odour, and its dull violet-blue colour.

In the *Uvarias* properly so called, as well as in those of the section *Asimina*, the inner petals are of the same size as the outer ones, or a little smaller, or rarely somewhat more developed. This last relation is that found, though but little marked, in two types referred by most authors to a very different group[6] of this order, namely, *Maren-*

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[1] This berry, whose external configuration is exactly represented in the work of RUIZ & PAVON, is closely analogous to that of *Uvaria*. The seeds are separated from each other by a thin soft prolongation of the endocarp. They are flattened and oval, and the arillary thickening of the outer coat is hardly indicated around the point of attachment, even less so than in *Asimina triloba* DUN.

[2] Only with some doubt have we referred to this group, our *Uvaria Hahniana* (*Adansonia*, viii. 347, n. 11), an American species, whose fruits (which have alone been examined) are very nearly those of *Porcelia* and *Asimina*, but whose seeds are regularly arranged in two parallel rows. The flowers are as yet unknown.

[3] SEEMANN, *Journ. of Bot.* iv. 369, t. liv.—B. H., *Gen.*, 956 (*Porcelia*).—H. BN., *Adansonia*, viii. 303.

[4] The petals are "from four to six inches long."

[5] They are thus represented by the author (SEEMANN), who describes them, however, as axillary. The foliage of this plant appears very much like that of *A. triloba*. According to the description, the imbrication of the corolla appears to be more marked than in *Asimina*, but this character is one that may vary greatly in one and the same genus, as we shall see below.

[6] That of the *Mitrephoreæ*, of which the corolla, often characteristic, is thus defined by BENTHAM & HOOKER (*Gen.*, 21): "*Petala valvata, exteriora aperta, interiora circa genitalia erecto-conniventia v. connata.*"

teria[1] (Madagascar) and *Anomianthus*[2] (Java). In all other respects their flowers and fruits present so exactly the structure of *Uvaria*, that we cannot remove them into distinct genera. As a section, we might strictly distinguish *Marenteria* by the arrangement of the flowers, which are borne on a long terminal peduncle; but we have hardly any similar character to give a clear distinction between *Anomianthus* and those true *Uvarias* in which the interior corolla is a little the longer. In both types the imbrication of the petals is well marked, and the calyx is gamosepalous, forming a sac with three obtuse teeth in *Marenteria*,[3] and more deeply divided in *Anomianthus*. The flowers of the latter are nearly sessile, while in *Marenteria* they are, as we have said, on a long peduncle.

Ellipeia[4] is easily distinguished from the other *Uvarias* by its ovules being solitary instead of indefinite; or there are more rarely two in each carpel. They are inserted at a variable height on the inner angle of the ovary, and are somewhat ascending. This character, which at first sight appears very significant, is, however, insufficient to establish a distinct genus in the order *Anonaceæ*; for it has been shown[5] that many other genera that are perfectly natural and accepted by all authors as such, include species with uni- or bi-ovulate ovaries, as well as species with many-seeded fruits. Everything else in the three species from the Indian Archipelago which have been described in this genus,[6] being like the characters of *Uvaria*—the imbricate corolla, the numerous stamens, with the connectives dilated and truncated above the anther-cells, the alternate hairy leaves, the sarmentose stems—we can only retain *Ellipeia* as a section of *Uvaria*,[7] with one-seeded fruits.[8]

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[1] NORON., ex DUP.-TH., *Gen. Nov. Madag.*, 18, n. 60.—B. H., *Gen.*, 957, n. 23, a.—H. BN., *Adansonia*, viii. 304, 325.—*Unona Marenteria* DC., *Syst.*, i. 487; *Prodr.*, i. 89, n. 4.—DUN., *Mon.*, 101.

[2] ZOLL., *Linnæa*, xxix. 324.—B. H., *Gen.*, 27, n. 26.—H. BN., *Adansonia*, viii. 304.

[3] In another species from Madagascar, which we have described under the name of *U. Commersonii* (*Adansonia*, viii., 316), the sepals are nearly free, while the carpels are far more numerous than in *Marenteria* DUPETIT-THOUARS, for this has only from three to five in each flower. The flower of *U. Commersonii* is leaf-opposed or terminal, on a shorter peduncle than in *U. Marenteria*; so that this species is, in most of its characters, intermediate between the typical *Marenteria*, and those sarmentose *Uvarias* of tropical Asia which possess terminal flowers on long peduncles, especially *U. Narum* WALL.

[4] HOOK. & THOMS., *Fl. Ind.*, i. 104.—B. H., *Gen.*, 23, 956, n. 6.—H. BN., *Adansonia*, viii. 305, 335.

[5] See *Adansonia*, viii. 175, 177, 180, 183.

[6] WALP., *Ann.*, iv. 50.—MIQ., *Fl. Ind.-Bat.* i. p. ii. 27; *Ann. Mus. Lugd. Bat.*, ii. 9.

[7] This fruit is surmounted by a small apiculus, which becomes more or less lateral through the unequal development of the different regions of the pericarp.

[8] We have been unable to study the genu *Sphærothalamus* HOOK. F. (*Linn. Trans.*, xxiii

Finally, in this genus, as in most of this order, there are species whose flowers are normally diclinous, such as *U. Burahol* Bl.,[1] which some authors have made the type of a special section, under the name of *Stelechocarpus*. Owing to the want of a gynæceum to the male flowers, the receptacle is covered with stamens to the very summit, and elongates into a cylinder with a conical end.[2]

Thus marked out, consisting of nine secondary groups,[3] which we consider as only subgenera whose limits are not well defined, the genus *Uvaria* contains half a hundred species, of which about four-fifths belong to the Old World;[4] the rest come from the United States, Mexico,[5] and the north-west of South America.[6]

Sageræa[7] consists of trees from tropical Asia, of which the hermaphrodite, or diclinous flowers are closely analogous to those of *Uvaria*. The calyx consists of three pieces, united for a certain extent, and imbricated in the bud; and the corolla is double, with

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156, t. 20; B. H., *Gen.*, 23, n. 5), specimens of which are rare in herbariums, that at Kew being probably the only one as yet known. According to the description given by the above author, *S. insignis* is a shrub from Borneo, with enormous alternate sessile leaves, cordate at the base, has flowers of an orange colour, with a globular receptacle; sepals three, large, orbicular, rigid, membranous; petals six, spathulate, in two verticils, imbricate (?); stamens indefinite, cuneiform, connective dilated and truncated above the cells; carpels indefinite (3–15), ovary surmounted by a very short obtuse style, and containing two (?) ventral ovules. The fruit is as yet unknown. Despite the external differences of size and form presented by the flowers and leaves of this plant, is it quite certain that it should constitute the type of a genus distinct from *Uvaria?* It is even possible that by its carpels, described as containing two superposed ovules, it becomes intermediate between the pluriovulate *Uvarias* and *Ellipeia* (see *Adansonia*, viii. 305, 336).

[1] *Fl. Jav.*, *Anonac.*, 13, t. xxiii. xxv. part.—Zoll., *Linnæa*, xxix. 303.—Miq., *Fl. Ind.-Bat.*, i. p. ii. 22; *Ann. Mus. Lugd. Bat.*, ii. 10.—Walp., *Ann.*, iv. 49.—H. Bn., *Adansonia*, viii. 329.

[2] The stamens are very numerous, formed like those of most *Uvarias*, and nearly sessile. The petals are glabrous and very concave. The gynæceum of the female flower is like that of a *Magnolia* on a small scale. The carpels are numerous, short, covered with stiff hairs. The style dilates rapidly and is divided into two lobes, as in many true *Uvarias*. The ovules are few in number; there are only two or three in each row. The fruit is borne on a long thick peduncle. Miquel also refers *U. Montana* Bl. to this group (*op. cit.*, 21).

[3] *Uvaria.* Sections 9.
1. *Euuvaria.*
2. *Synuvaria* (H. Bn.).
3. *Asimina* (Adans.—*Orchidocarpum* Michx.).
4. *Porcelia* (R. & Pav.—*Sapranthus* Seem.).
5. *Narum* (Hook. & Thoms.).
6. *Marenteria* (Dup.-Th.).
7. *Anomianthus* (Zoll.).
8. *Ellipeia* (Hook. & Thoms.).
9. *Stelechocarpus* (Bl.).

[4] Dun., *Mon.*, 82, 85, 88.—DC., *Prodr.*, i. 87, 88.—A. DC., *Mém.*, 25.—Bl., *Fl. Jav.*, *Anonac.*, 9, 41.—Walp., *Rep.* i. 79; *Ann.*, ii. 19; iv. 45, 49; vii. 50, 54,—Harv. & Sond., *Fl. Cap.*, i. 8.—Zoll., *Linnæa*, xxix. 303, 312, 324 (*Anomianthus*).—Benth., *Linn. Trans.*, xxiii. 464; *Fl. Hongkong.*, 9; *Fl. Austral.*, i. 50.—Hook. & Thoms., *Fl. Ind.*, i. 95, 104 (*Ellipeia*).—Miq., *Fl. Ind.-Bat.*, i. p. ii. 22; *Ann. Mus. Lugd. Bat.*, ii. 2, 9.—Thwait., *Enum. Pl. Zeyl.*, 6.—Seem., *Fl. Vitiens.*, 4.—F. Muell., *Fragm.*, iii. 1; iv. 33 (*Fitzalania*).—H. Bn., *op. cit.*, viii. 346.

[5] Torr. & Gr., *op. cit.*—Michx., *Fl. Bor.-Amer.*, i. 329 (*Orchidocarpum*) (see p. 187).—H. Bn., *Adansonia*, viii. 347.

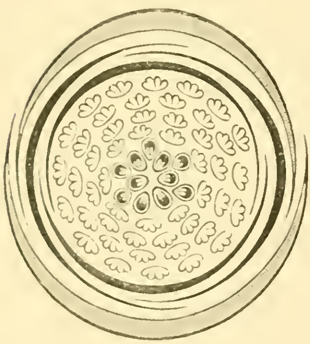
[6] Ruiz & Pav., *Prodr.*, 84, t. 16 (*Porcelia*).—Seem., *Journ. of Bot.*, iv. 369. t. liv (*Sapranthus*).

[7] Dalz., *Hook. Journ.*, iii. 207.—B. H., *Gen.*, 22, 955, n. 1.—H. Bn., *Adansonia*, viii. 336.

imbricated petals. Above these parts, the floral receptacle forms a flattened head, with broad facets corresponding to the insertions of the stamens and carpels. The former are few in number, being about as numerous as the pieces of the perianth; they are shaped like an inverted pyramid, with an extrorse two-celled anther dehiscing longitudinally, above which the connective expands into a truncate plate.[1] There are the six large scales external to the fertile stamens,[2] which we should probably consider as sterile ones, which in *S. laurina* DALZ., for example (fig. 230), simulate a third corolla internal to the six normal petals. The carpels are either few in number, for we sometimes only count from two to six, or else indefinite. Their ovary contains along its inner angle an indefinite number of ovules in two vertical rows. The fruit consists of one or more swollen, nearly globular, one or many-seeded berries. The three or four species of this genus are Indian plants,[4] with alternate, glabrous coriaceous leaves, and axillary or lateral flowers, solitary, or more frequently collected into cymes.

Sageræa laurina.[3]
FIG. 230.
Flower ($\frac{5}{1}$).

Tetrapetalum (fig. 231)[5] may be defined as *Uvaria*, with dimerous floral verticils. In fact, on the slightly convex receptacle, we find two much imbricated sepals, and four alternatively imbricated, rounded,



Tetrapetalum volubile.
FIG. 231.
Diagram.

[1] These stamens have the prolongation of the connective above the anther-cells tapering and bent inwards, so as to recall pretty closely the form of the stamens in *Milliuseæ*, and hence it is, no doubt, that some species of *Sageræa* were originally placed in the genus *Bocagea*.

[2] H. BN., *Adansonia*, viii. 328. In fact, the form of these scales, as represented in fig. 230, their thickness and consistency, indicate a great analogy to the fertile stamens interior to them. The upper border of each is divided into four little festoons, each of which appears to answer to the summit of a rudimentary half-cell; and we can even see three very shallow furrows on the outer face, that terminate above in the notches between the festoons. We do not know whether these sterile organs exist in other species than *S. laurina*, DALZ.; if so, the descriptions make no mention of the fact.

[3] *Gnatteria laurifolia* GRAH., *Cat. Bomb.*, 4.

[4] HOOK. & THOMS., *Fl. Ind.*, i. 93.—GRAH., *Cat. Bomb.*, *loc. cit.*—WALP., *Rep.*, i. 76, 4, *Ann.*, iv. 50; vii. 50.—THWAIT., *Enum. Pl. Zeyl.*, 6.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 21; *Ann. Mus. Lugd. Bat.*, ii. 10.

[5] MIQ., *Ann. Mus. Lugd. Bat.*, ii. 8.—B.H., *Gen.*, 955, n. 2 *a*.—H. BN., *Adansonia*, viii. 336.

concave, caducous petals. The stamens and multiovulate carpels are exactly those of *Uvaria*. The fruit is as yet unknown. Only one species of this genus has as yet been described,[1] a shrub from Borneo, whose flexible twining branches are covered with alternate leaves, and whose flowers are arranged in dense leaf-opposed or lateral spikes.

In *Cananga*,[2] the flowers are constructed on the same plan as in *Uvaria*, differing only in a few characters of secondary importance. The receptacle is convex,[3] bearing in succession a calyx of three sepals, valvate in the bud, and two corollas each of three equal, or nearly equal, petals imbricated in the bud, and spreading on the expansion of the flower. The stamens are very numerous, and closely packed in a spiral; their anthers are extrorse, with two parallel cells, surmounted by a truncated dilatation of the connective. Above the androceum, the apex of the receptacle presents a circular platform, often surrounded by a slightly projecting rim. On this surface are inserted the indefinite carpels, each consisting of a one-celled ovary, surmounted by a nearly sessile swelling covered with stigmatic papillæ. At the base of the ovary is a placenta, bearing an ascending or erect ovule, with its micropyle outwards and downwards. The fruit is multiple (fig. 232), consisting of an indefinite number

Cananga (*Guatteria*) *Schomburgkiana*.
FIG. 232.
Fruit.

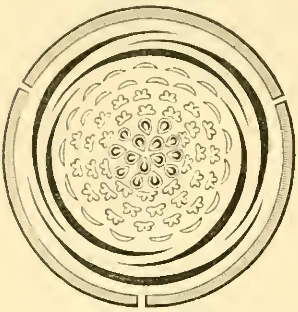
[1] *T. volubile* MIQ., *loc. cit.* Nearly all the organs of this plant are covered with rufous hairs, like those of most *Uvarias*.

[2] AUBL., *Guian.*, i. (1775) 607, t. 244 (RUMPH., *Herb. Amboin.*, ii. (1741) 195, t. 65; HOOK. F. & THOMS., *Fl. Ind.*, i. 129).—*Guatteria* R. & PAV., *Prodr.* (1794) 85, t. 17 (in *Auctt. Flor. Asiatic.*).—DUN., *Mon.*, 50, t. 30-32.—DC., *Syst.*, i. 502; *Prodr.*, i. 93.—ENDL., *Gen.*, n. 4721.—B. H., *Gen.*, 23, n. 7. We have explained (*Adansonia*, viii. 336,) why the generic name of AUBLET should in any case retain its priority, though it does not apply to the same plants as the genus *Cananga* of RUMPHIUS. These last are, in our opinion, *Unonas*, and the name of *Guatteria* was only created by RUIZ & PAVON nineteen years after the publication of AUBLET's work; so that the name *Cananga*, as applied by AUBLET, has still nineteen years' priority.

[3] It is often dome-shaped, except in that superior truncated part (*torus apice truncatus*), forming a sort of platform which bears the gynæceum, and is surrounded by a small annular pad, of which we shall speak below. This must be considered nothing else than the first rudiment of the receptacular sac, found so greatly developed in most species of *Xylopia*.

of stipitate one-seeded berries. The erect seed contains ruminated albumen, and a nearly apical embryo. This genus consists of trees and shrubs from the warm regions of America; about fifty species have been described.[1] They have alternate leaves; and the flowers, solitary or united into few-flowered cymes, are axillary, lateral, terminal, or sometimes leaf-opposed.

In *Aberemoa*[2] the petals are imbricated, as in *Uvaria* and *Cananga*;[3] and the carpels are multiovulate, as in the latter. The style surmounting them often tapers into a sort of sharp horn. But the fruit does not consist of a number of stipitate berries, arranged in an umbel as in *Cananga*; its structure is usually similar to that of the *Anonas*, which we shall study a little later on. It is an ovoid or spherical, fleshy or woody mass, formed by the union of all the carpels; a union which may be so intimate as almost to obliterate all traces of the different styles on the surface of the fruit (fig. 235). In others we can distinguish their tips as more or less prominent points;[4] and it may happen that the berries, almost woody, are free to the base; but in that case the common receptacle swells into a thick pyriform, or nearly pyriform mass, to support them, the whole always presenting a very peculiar aspect.[5] The seeds are arillate, with very copious, fleshy, ruminated albumen. In one species of this genus, described



Aberemoa (Fusæa) longifolia.
FIG. 234.
Diagram.

[1] WALP., *Rep.*, i. 82; ii. 747; *Ann.*, iv. 72; vii. 52.—DC., *loc. cit.*; *Icon. Deless.*, i. 24, t. 90.—A. DC., *Mém.*, 40.—A. S. H., *Fl. Bras. Mer.*, i. 36.—MART., *Fl. Bras.*, *Anonac.*, 25, t. 7-12. — SCHLTL., *Linnæa*, ix. 320. — PL. & TRIANA, *Ann. Sc. Nat.*, sér. 4, xvii. 31.—H. BN., *Adansonia*, viii. 268.

[2] AUBL., *Guian.*, i. 610, t. 245.—H. BN., *Adansonia*, viii. 336.—*Duguetia* A. S. H., *Fl. Bras. Merid.*, i. 35, t. 6, 7.—A. DC., *Mém.*, 40.—ENDL., *Gen.*, n. 4722.—B. H., *Gen.* 23, n. 8.—H. BN., *Adansonia*, viii. 326.—*Cardiopetalum* SCHLTL., *Linnæa*, ix. 328.

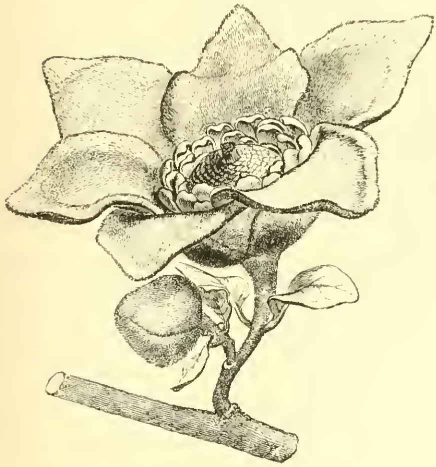
[3] The receptacle sometimes presents the same form as in this genus; its summit is concave in *Duguetia bracteosa* MART. The petals, often marked inside by a dark spot at the base, may be very thick and, as it were, shagreened, like those of *Asimina triloba*; this is very marked in *Anona furfuracea* A. S. H. (*Fl. Bras. Mer.*, i. 34, t. 6), which is an *Aberemoa*.

[4] Some species, such as *Anona calycina*, SAG. (Guiana) have the carpels hardly distinct in the green fruit, but when ripe they fall off from the common receptacle, together with the seed that each encloses, no longer surrounded by the pericarp towards its base.

[5] This is the case in *Duguetia lanceolata* A. S. H., the typical species of the genus *Duguetia*. Its carpels are free to the base, and the common receptacle supporting them is swollen into a sort of woody pear, with one facet corresponding to each carpel.

by AUBLET[1] under the name of *Anona longifolia* (figs. 233, 235), the outer stamens are sterile and transformed into imbricated petaloid blades, while the surface of the ripe fruit is also nearly smooth, features sufficient to characterize a special section of the genus *Aberemoa*.[2]

This genus consists of South American trees and shrubs, whose



Aberemoa (Fusæa) longifolia.

FIG. 233. Inflorescence.

FIG. 235. Fruit.

alternate leaves and young branches are usually covered with scaly or stellate hairs. The flowers are solitary, or in uniparous two-flowered cymes,[3] either terminal, leaf-opposed, or lateral.[4] About

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[1] *Guian.*, i. 615, t. 248.—*Duguetia longifolia* H. BN., *loc. cit.*

[2] We have called it *Fusæa* (*Adansonia*, viii. 326). This section is also distinguished by its inflorescence, by these petaloid staminodes external to the fertile stamens, by the union of the styles at the top into a single mass, and by the structure of the fruit, which finally becomes a spherical woody mass, like a wooden ball hollowed out into monospermous cells and whose surface gives but little indication of the fact that this multiple fruit really consists of a large number of ovaries originally free (see fig. 235).

[3] It is in this way that they are arranged in *A. longifolia*, represented in fig. 233. Moreover we see that the bracts on the axes of the different generations may have leaf-buds in their axils. There are also two flowers of different generations in the inflorescence of *Anona? uniflora* DUN. (*Mon.*, 76; DC., *Prodr.*, i. 86, n. 24; *Icon. Deless.*, i. 23, t. 87), which is an *Aberemoa*, but whose specific name must needs be changed for this reason. Accordingly we have proposed (*Adansonia*, viii. 327) to call it *Duguetia Candollei*.

[4] The situation of the inflorescence is lateral in *A. longifolia*. The uniparous cyme really arises from the axil of a leaf, a leaf that has already fallen, on a last year's branch. Beside it, and from the same axil, a young branch developes at the same time. Now the inflorescence rises up and remains united to a very variable extent by its peduncle either to the young branch or to the last year's one. Something analogous may be observed in *Monodora*.

fifteen species are known, most frequently described as belonging to the genus *Anona*;[1] in fact, we may say that *Aberemoa* is *Anona* with all the petals imbricated.

Cleistochlamys[2] has small axillary sessile flowers of the same general structure as in *Cananga* and *Aberemoa*: the imbricated petals are inserted on a slightly convex receptacle, as are the indefinite stamens, whose extrorse anthers are surmounted by a truncate dilatation of the connective; above the stamens are the uniovulate carpels, of variable number,[3] with narrow, slightly capitate styles. But the calyx is a sort of irregular sac, at first closed, and afterwards torn irregularly into two, three, or four unequal parts. The fruit consists of several elongated, stipitate, one-seeded berries. But one species[4] of this genus is known—a small glabrous tree from the east of tropical Africa, with oval-oblong leaves; its habit is that of several species of *Popowia*, a genus to which it was at first referred.

Oxandra[5] has small flowers, like *Cleistochlamys*; but the calyx consists of three imbricate leaves, not of a valvate sac of one single piece. The six petals are imbricated, as in *Uvaria*; and the stamens are of the form termed "*stamina Miliusearum*." They are indefinite, but not generally numerous, any more than the carpels. Taking, for instance, the flower of *O. espintana*[6] (fig. 236), we see that the androceum consists of only a couple of rows of stamens within the perianth. These are lanceolate in form, and end in a long point, which is simply the apex of the connective, and is quite continuous with the filament. To the outer face of this body are applied two parallel linear, extrorse anther-cells, dehiscing longitudinally. The carpels are five or six in number, grouped into a crown on the slightly

Oxandra espintana.
FIG. 236.
Flower ($\frac{6}{1}$).

[1] MART., *Fl. Bras.*, *Anonac.*, 22, t. 5.—SCHLTL., *loc. cit.*, 320, 328.—WALP., *Rep.*, i. 85; ii. 747; *Ann.*, i. 17; iii. 813; iv. 57.

[2] OLIV., *Journ. Linn. Soc.*, ix. 175.—B. H., *Gen.*, 956, n. 6, *a*.—H. BN., *Adansonia*, viii. 336.

[3] There are from five to ten. The ovule is nearly basilar with the micropyle downwards and outwards.

[4] *C. Kirkii* OLIV., *loc. cit.*—*Popowia? Kirkii* BENTH., *Linn. Trans.*, xxiii. 470, n. 2. The species was found on the banks of the Zambesi by Dr. KIRK in LIVINGSTONE's expedition.

[5] A. RICH., *Fl. Cub.*, 20, t. viii.—H. BN., *Adansonia*, viii. 168, 336.—*Bocagea* B. H., *Gen.*, 29, n. 39 (A. S. H., *Fl. Bras. Mer.*, i. 41).

[6] H. BN., *loc. cit.*, 166.—*Bocagea espintana* SPRUCE, ex BENTH., *Journ. Linn. Soc.*, v. 71.

flattened summit of the receptacle. The ovaries taper into a hooked style, with a stigmatiferous apex, and contain a nearly basilar ascending ovule with the micropyle downwards and outwards. The flower is borne on a peduncle, which, like that of *Chimonanthus*, bears imbricated bracts all over its surface; they are analogous to sepals, and become shorter as they are lower down. Here they are distichous, thick, and scarious. In other species, such as *O. lanceolata*[1] and *laurifolia*,[2] these scales do not occupy the whole length of the peduncle, but are massed together near its base, to which they form a sort of sheath or involucre. The form of the perianth is here somewhat modified. The flower-bud, nearly globular in *O. lanceolata*, becomes elongated in *O. laurifolia*, chiefly through the conformation of the petals. The stamens and carpels are numerous in the latter species. Four or five[3] species of *Oxandra*[4] are known—shrubs from the Antilles and the north of South America, with alternate entire leaves, and a fruit consisting of a variable number of one-seeded, shortly stipitate berries.

B. Unoneæ.—This secondary group is named after the genus *Unona*,[5] which differs from *Uvaria* in one essential point only: the fact that its corolla is valvate, not imbricate, in æstivation. In all else the flowers of that section of the former genus termed *Pseudo-Unona*[6] are perfectly similar to these latter—the trimerous calyx; the nearly equal, sessile, flattened petals spreading on the expansion of the flower; the indefinite stamens inserted in a spiral, and each

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[1] H. Bn., *loc. cit.*, 168, n. 4.—*O. virgata* A. Rich., *loc. cit.*—*Uvaria lanceolata* Sw., *Prodr.* (1788), 87.—*U. virgata* Sw., *Fl. Ind. Occ.* ii. (1800), 999.—*Cananga virgata* DC.—*Guatteria virgata*, Dun., *Mon.*, 133, t. 31; DC., *Prodr.*, i. 94, n. 14.—*Drimys lancea* Poit.—*Bocagea virgata* B. H., *loc. cit.*

[2] A. Rich., *loc. cit.*; H. Bn., *loc. cit.*, n. 3.—*Uvaria laurifolia* Sw., *loc. cit.*—*U. excelsa* Vest., ex Vahl.—*Cananga laurifolia* DC.—*Guatteria laurifolia* Dun., *op. cit.*, 132, t. 32; DC., *loc. cit.*, n. 15.—*Bocagea laurifolia* B. H., *loc. cit.* In these species there is always a single ascending nearly basilar ovule. The petals are broad and short in *O. lanceolata*, far longer and narrower in proportion in *O. laurifolia*. In both plants the stamen is like a thick fleshy elongated spindle, very acute at the apex; the cells are like linear rods applied to the outer surface of the stamen; and the filament, the body of the connective, and its long apical point form one continuous whole. The carpels and stamens are constructed on the same plan in *O. laurifolia* and *lanceolata*.

[3] The latter would be the only true number if it were shown that *Bocagea leucodermis* Spruce (Benth., *Journ. Linn. Soc.*, v. 71; H. Bn., *op. cit.*, 167) is also a species of *Oxandra*; but its flowers are very imperfectly known.

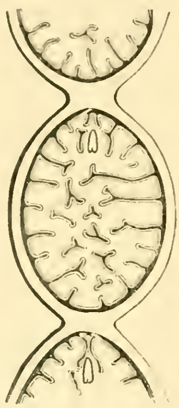
[4] A. Rich., *loc. cit.*—Pl. & Triana, *Ann. Sc. Nat.*, sér. 4, xvii. 36.—H. Bn., *op. cit.*, 166, 167, 169.

[5] L. Fil., *Suppl.*, 270.—Juss., *Gen.*, 283; *Ann. Mus.*, xvi. 340.—Dun., *Mon.*, 99, t. 26.—DC., *Syst.*, i. 485; *Prodr.*, i. 88.—Spach, *Suit. à Buff.* vii. 517.—Endl., *Gen.*, n. 4717, *b.*—B. H., *Gen.*, 24, 956, n. 13.—H. Bn., *Adansonia*, viii. 175, 327 (incl. *Cananga* Rumph.;—*Melodorum* Dun.;—*Kentia* Bl.;—*Mitrella* Miq.;—*Polyalthia* Bl.;—*Ancana* F. Muell.;—*Meiogyne* Miq.;—*Trigyneia* Schltl.;—*Hexalobus* A. S. H. & Tul. (see A. DC.);—*Monoon* Miq.;—*Pyramidanthe* Miq.;—*Trivalvaria* Miq., pass. descr.).—*Desmos* Lour., *Fl. Cochinch.*, ed. Ulyssip., 352.

[6] Hook. & Thoms., *op. cit.*, 135. Here the

surmounted by a dilatation of the connective; the carpels also of variable number; the numerous ovules inserted on the inner angle; the compound fruit consisting of many-seeded berries, with the pericarp but little or not at all strangulated in the intervals between the seeds. The species not belonging to this section are distinguished by the strangulations being, on the contrary, very well marked, so that each berry looks like a chaplet with a variable number of seeds. Each compartment contains a single suspended seed, with ruminated albumen (figs. 237, 238).

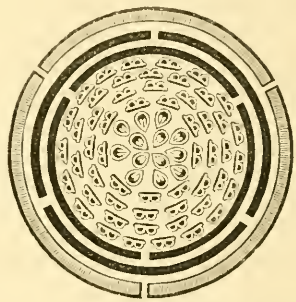
Under the generic name of *Cananga*[1] has been distinguished an



Unona discolor.

FIG. 237. Berry.

FIG. 238. Long. section of berry ($\frac{4}{1}$).



Unona (Canangium) odorata.

FIG. 239. Diagram.

FIG. 240. Stamen ($\frac{8}{1}$).

Indian species, *U. odorata*[2] (figs. 239, 240), introduced into almost

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carpels have no strangulations between the seeds. But these strangulations exist, on the contrary, and are sometimes very well marked in the species called *Desmos* (DUN. ex DC., *Syst.*, i. 493) and *Dasymaschalon* (HOOK. & THOMS., *loc. cit.*, 134). The whole of the species in which these contractions are wanting or but slightly marked are included by DE CANDOLLE in his section *Unonaria* (*Syst.* i. 486; *Prodr.* i. 89), which includes several species alien to the genus *Unona*. His section *Elania* (*Prodr.*, i. 90) only included *U. tripetala* DC. (*Syst.*, i. 490.)

[1] RUMPH., *Herb. Amboin.*, ii. 195.—HOOK. & THOMS., *Fl. Ind.*, i. 129.—B. H., *Gen.*, 24, n. 12 (nec AUBL.).

[2] DUN., *Mon.*, 107, t. 26.—DC., *Syst.*, i. 492; *Prodr.*, i. 90, n. 18.—*U. leptopetala* DC., *Syst.*, i. 496; *Prodr.*, i. 91. n. 30; *Icon. Deless.*, i. 23, t. 88.—*U. velutina* GÆRTN., *Fruct.*, ii. t. 101, f. 2.—BL., *Fl. Jav.*, *Anonac.*, 31 (nec DUN., nec ROXB.).—*Uvaria odorata* LAMK., *Dict.*, i. 595.—*U. Cananga* VAHL, ex HOOK. & THOMS.—*U. axillaris* ROXB., *Fl. Ind.*, ii. 667.—*U. Gærtneri* DC., *Prodr.*, i. 88, n. 3.—*U. farcta* WALL., *Cat.*, n. 6460.—*Cananga odorata* ROXB., *Fl. Ind.*, ii. 661.—WALL., *Cat.*, n. 6457.—BLUME, *Bijdr.*, 14; *Fl. Jav.*, *Anonac.*, 29, t. 9, 14 B.—HOOK. & THOMS., *Fl. Ind.*, i. 129.—WALP., *Ann.*, iv. 64. In this plant the petals are more or less elongated. The receptacle is convex, but its summit is slightly hollowed out at the insertion of the gynæceum. The stamens often stick together by the sides of their glandular connectives. It may happen that some of the outermost contain no pollen; they are then only simple petaloid scales. The seed may possess an aril with two well-developed lateral lobes; but this organ is sometimes rudimentary.

every warm climate, whose corolla is much elongated, while the stamens are surmounted by an acute prolongation of the connective. The berries are slightly contracted between the seeds. The other differentiating characters cited to separate this plant from *Unona* having no real existence, we have thought it right not to retain it in a distinct genus.

In certain other *Unonas* which form the section *Dasymaschalon*,[1] the outer petals become far more elongated still; the inner ones remain small, or are even altogether wanting. This is usually the case in the flowers of *U. longiflora*,[2] in which the corolla is as much as from $2\frac{1}{2}$ to 3 inches [6 to 8 centimetres] in length. The number of ovules is often not great in the carpels of this species; certain ovaries contain no more than two, inserted at variable heights on the inner angle.[3] This number is constant in certain species from tropical Asia; and it has been impossible to separate them generically from the other *Unonas*, for there is no dissimilarity in any other character.

It has been proposed to establish a fresh genus *Meiogyne*,[4] for a Javanese *Uvaria*, whose flowers have rather short buds, and only five, four, or even three carpels. This generic section has not been adopted. It has been truly remarked with reference to this, that there is an African species of *Unona*,[5] which we cannot exclude from the genus, with a corolla differing in form from that of *Meiogyne*, but, like that plant, with but few carpels. Now this species has all the essential characters of the American *Unonas* described under the name of *Trigyneia*.[6] The perianth of the latter may have exactly the same conformation, and the generic name shows that the same reduction[7] in the number of carpels has been observed in the proto-

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[1] See p. 201, note 6.

[2] ROXB., *Plant. Coromand.*, iii. 87, t. 290; *Fl. Ind.*, ii. 668.—HOOK. & THOMS., *Fl. Ind.*, i. 134.—WALP., *Ann.*, iv. 67.—H. BN., *Adansonia*, viii. 176. The single whorl that represents the corolla may be even reduced to two equal or unequal pieces, free, or united for a very variable height.

[3] They are sometimes almost superposed. Nevertheless each is placed on one lip of the placenta. Sometimes the one is almost basilar: by this means we cannot distinguish this plant from *Polyalthia*, properly so called.

[4] MIQ., *Ann. Mus. Lugd. Bat.*, ii. 12.—B. H., *Gen.*, 956, n. 13.—H. BN., *Adansonia*, viii. 337. *Ancana*, too, has been proposed as a distinct genus, simply on account of the small number of its carpels.

[5] B. H., *Gen.*, *loc. cit.*—*U. Oliveriana* H. BN., *Adansonia*, viii. 307. In this species most of the organs are covered by very fine scaly hairs. There are from three to five carpels. In the former case they are superposed to the outer petals. In the bud the corolla has exactly the same form as that of certain species of *Melodorum*, a triangular pyramid, with somewhat blunted angles.

[6] SCHLTL., *Linnæa*, ix. 328.—BENTH., *Journ. Linn. Soc.*, v. 69.—B. H., *Gen.*, 25, n. 15. H. BN., *Adansonia*, viii. 178, 337.

[7] The number of carpels is also, as we have seen, much reduced in *Ancana* F. MUELL., which

type species.[1] Many other species have since been observed in Guiana, Brazil, and Peru,[2] in which the carpels become as numerous as in the true *Unonas* of the Old World. In some of the latter the carpels are, as we have seen, few in number. In *Monocarpia*[3] there is only a single one, and yet we cannot retain it as a distinct genus, for many other perfectly natural genera of the same order contain species with several ovaries as well as species with only one.

Melodorum[4] has been considered by some as a section of the genus *Unona*, by others as a perfectly autonomous genus. It has, however, the indefinite multiovulate carpels and the valvate perianth of the true *Unonas*. The corolla, it is true, may undergo very great modifications in the form and thickness of its parts. In certain species it is all together globular in the bud, while in others it has exactly the same form that is common in *Xylopia*, a form even exaggerated in *Pyramidanthe*.[5] Only this character cannot be considered of any absolute value, as there are species of *Melodorum* with conical buds, whose petals are exactly those of some *Unonas*, and, on the other hand, we may have globular buds in the latter genus.

The same observation applies to *Kentia*,[6] whose general floral

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BENTHAM & HOOKER (*Gen.*, 956, n. 13) refer to the genus *Unona* (see p. 203, note 4).

[1] *Trigyneia oblongifolia* SCHLTL., *loc. cit.*—*Uvaria trigyna* MART., *Fl. Bras.*, *Anonac.*, 40.

[2] H. BN., *Adansonia*, viii. 179–181. We have referred to this group the following species: 1. *Anona peduncularis* STEUD; 2. *Uvaria guatterioides* A. DC; 3. *Anona Perrottetii* A. DC. In a plant that we can only consider as a form (*lanceolata*) of this last species, we have only found one ascending ovule in each carpel, just as in our *Trigyneia rufescens* (*loc. cit.*, 180, note 1), while in *T. Mathewsii* BENTH. and the species above enumerated, the number of ovules is greater. In the former case, the seed is ellipsoidal, with a longitudinal ridge along its edge. When the seeds are numerous, they are reduced to flattened disks, piled up like a rouleau of coins, and the projecting circular rim is horizontal, occupying the only portion of the surface of the seed that is not in contact with its neighbours.

[3] MIQ., *Ann. Mus. Lugd. Bat.*, ii. 12.—B. H., *Gen.*, 956. n. 13, *a*.—H. BN., *Adansonia*, viii. 338.

[4] DUN., *Mon.*, 115 (sect. *Unonæ*).—BL., *Fl. Jav.*, *Anonac.*, 13, t. 15 (sect. *Uvariæ*).—DC., *Syst.*, i. 497; *Prodr.*, i. 91.—ENDL., *Gen.*, n. 4717, *a*.—B. H., *Gen.*, 28, 958, n. 31.—MIQ., *Fl. Ind. Bat.*, i. p. ii. 34; *Ann. Mus. Lugd. Bat.*, ii. 37.—HOOK. & THOMS., *Fl. Ind.*, i. 115. —THW., *Enum. Pl. Zeyl.*, 6.—ZOLL., *Linnæa*, xxix. 317.—BENTH., *Linn. Trans.*, xxiii. 477; *Fl. Austral.*, i. 52.—WALP., *Ann.*, iv. 57.—H. BN., *Adansonia*, viii. 296, 306, 328.—(an LOUR., *Fl. Cochinch.*, ed. Ulyssip., 351?).—*Cyathostemma* GRIFF., *Notul.*, 707, t. 650.

[5] MIQ., *Ann. Mus. Lugd. Bat.*, ii. 39.—H. BN., *Adansonia*, viii. 329.—Several species of *Melodorum*, properly so called, present this elongated form of the flower-bud, as BENTHAM & HOOKER very justly remark (*Gen.*, 958). Others have a conical bud, with the petals of a uniform, or nearly uniform, thickness all over, as in certain species of *Unona* and *Polyalthia*. Others again have a globular bud, like that of *Anona globiflora*. The stamens are often surmounted by an acute prolongation of the connective; but this character has no absolute value, being wanting in several species of *Melodorum* proper. In *M. africanum* BENTH. (*Linn. Trans.*, xxiii. 477), we have observed that the outer stamens are often transformed into petaloid scales, as occurs in several species of *Aberemoa*, *Xylopia*. &c.

[6] BL., *Fl. Jav.*, *Anonac.*, 71, t. 58 (sect. *Polyalthiæ*).—B. H., *Gen.*, 28, n. 31 (2).—

organization is the same as in *Melodorum*, but whose ovaries only contain one or two ovules inserted at a variable height on the inner angle. The corolla often forms a triangular pyramid in the bud and the upper halves of the petals have thick edges, while the lower halves alone are hollowed out, and as it were moulded on the sexual organs.

The limited number of ovules has not been made use of to separate *Kentia* from *Melodorum* proper. Indeed, it could not be, because this character is considered valueless in many other generic groups, and because there is a plant from Guiana whose ovaries only contain one or two ovules,[1] which we cannot separate from the multiovulate American genus *Trigyneia*. Between this plant and the pluriovulate *Trigyneias* we have a very good transition, as we have shown, in the typical species of the section *Unonastrum*,[2] a Mexican plant with from two to six ovules[3] in its ovaries. Its young seeds, few in number, are inserted either near the base or at a variable height on the internal angle of the ovary, according as the missing ones are the superior or the inferior ones.

Among the Old World *Unonas* also there are species whose carpels are almost constantly biovulate; they have been termed *Polyalthia*,[4] and have been erected into a distinct genus. The corolla is of very variable form. When they have but a single ovule they are termed *Monoon*;[5] or *Trivalvaria*,[6] when in addition to

Mitrella Miq., *Ann. Mus. Lugd. Bat.*, ii. 38. B. H., *Gen.*, 958. In the flowers of *Melodorum pisocarpum*, for instance, the corolla is nearly globular in the bud. The outer petals are very thick, with very broad borders above, while their bases are, as it were, hollowed out internally to lodge part of the other corolla. The pieces of the latter are narrower, shorter, and thinner, but are also sessile, and their thickened apices project like the keystone of the hanging vault they form in the centre of the flower-bud. Above the anther-cells the stamens only present a somewhat elongated prolongation of the connective, obtuse and dilated at the apex. The interior of the ovary cells is full of a thick, gummy juice; and in the inner angle we see two ovules, one inserted a little above the ovary, about halfway up the cell. They are ascending, with the micropyles looking outwards and downwards, while, owing to a slight obliquity, their chalazal ends are near one another. In the prototype of the section *Kentia*, that is, *Polyalthia Kentii* Bl. (*Mitrella Kentii* Miq., *Ann. Mus. Lugd. Bat.*, ii. 39), by their apposition in the bud the pieces of the outer corolla form a sort of three-sided pyramid.

1 *T. Perrottetii*, var. *lanceolata* H. Bn., *Adansonia*, viii. 179, note 5.

2 *T. Galleottiana* H. Bn., *op. cit.*, 181, note 1, 268.

3 Four is the commonest number, echeloned along the internal angle of the ovary; but they are inserted nearer the top or the bottom according as the lower or the upper ones are wanting.

4 Bl., *Fl. Jav.*, *Anonac.*, 70, t. 33, 34 (ex part.).—A. DC., *Mém.*, 39.—Endl., Gen., n. 4713 (ex part.).—Miq., *Fl. Ind.-Bat.*, i. p. ii. 43; *Ann. Mus. Lugd. Bat.*, ii. 13.—Hook. & Thoms., *Fl. Ind.*, i. 137.—Spach, *Suit. à Buffon*, vii. 505, 510.—Zoll., *Linnæa*, xxix. 321.—Seem., *Fl. Vit.*, 4, t. iii.—Thw., *Enum. Pl. Zeyl.*, 9.—B. H., *Gen.*, 25, 956, n. 17.—Walp., *Ann.*, iv. 68; vii. 55.—Benth., *Linn. Trans.*, xxiii. 470; *Fl. Austral.*, i. 51.—H. Bn., *Adansonia*, viii. 175, 318.

5 Miq., *Ann. Mus. Lugd. Bat.*, ii. 15.—B. H., *Gen.* 956, n. 17.—H. Bn., *Adansonia*, viii. 337.

6 Miq., *Ann. Mus. Lugd. Bat.*, ii. 19.—B. H., *Gen.*, *loc. cit.*—H. Bn., *loc. cit.*

this the petals, shorter, thicker and more angular, give the bud a pyramidal form. Finally, there is in this genus a plant which, with the same general floral organization as in *U. Oliveriana*, has a gamopetalous corolla which falls in a single piece. It was called *Hexalobus brasiliensis*,[1] and was afterwards brought near *Trigyneia* properly so called. It is certainly to *Unona* what those species of *Uvaria*, whose petals are united at the base, are to that genus.

Thus formed by the union of a large number[2] of genera kept separate by the most recent authors, the genus *Unona* contains about eighty species from tropical regions of both hemispheres, of which only about one-tenth belong to America.[3] They are trees or shrubs, sometimes creepers, almost always glabrous, with alternate exstipulate leaves, and flowers solitary or grouped into few-flowered cymes, axillary, extra-axillary, leaf-opposed or terminal. From the preceding description we see that we may very well describe *Unona* as *Uvaria* with a valvate corolla, and hence those species of *Uvaria*, *Asimina*, and *Ancana*, in which three petals are valvate at a certain period, form a passage between the two genera, which could not be placed in tribes separated by impassable limits.[4]

Anaxagorea[5] is the name given to certain plants with the flowers of certain *Polyalthias or Kentias*, but whose fruit is a one- or two-seeded follicle. The calyx consists of three membranous or valvate sepals, free, or cohering below, spreading or reflexed on the expansion of the flower. The petals are valvate, of very variable thickness according to the species, and the inner ones are as large as the outer ones, or smaller.[6] The receptacle, more or less convex, then bears a

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[1] A. S. H. & Tul., *Ann. Sc. Nat.*, sér. 2, xvii. 133, t. 6.—*Trigyneia* B. H., *Gen.*, 24, n. 11; 25, n. 15. Except for its united petals this species comes very near our *Unona Oliveriana*, (see p. 203, note 5).

[2] *Unona.* Sections 15.
1. *Unonaria* (DC.) (*Pseudo-Unona* Hook. & Thoms.).
2. *Desmos* (Lour.).
3. *Dasymaschalon* (Hook. & Thoms.).
4. *Ancana* (F. Muell.).
5. *Meiogyne* (Miq.).
6. *Trivalvaria* (Miq.).
7. *Canangium* (*Cananga* Rumph., nec Aubl.).
8. *Pyramidanthe* (Miq.).
9. *Melodorum* (Bl.).
10. *Unonastrum* (H. Bn.).

Unona, contd Sections 15.
11. *Trigyneia* (Schltl.).
12. *Kentia* (Bl.) (*Mitrella* Miq.).
13. *Polyalthia* (Bl.).
14. *Monoon* (Miq.).
15. *Monocarpia* (Miq.).

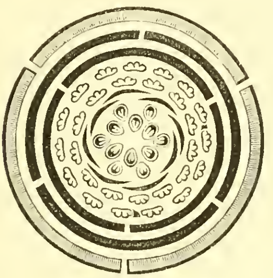
[3] The sections *Trigyneia* and *Unonastrum* (see pp. 203, 205).

[4] On this subject, see *Adansonia*, viii. 309.

[5] A. S. H., *Bull. Soc. Philomat.* (1825), 91.—Bl., *Fl. Jav.*, *Anonac.*, 64, t. 32.—A. DC., *Mém.*, 35.—Endl., *Gen.*, n 4719.—A. Gray, *Amer. Expl. Exped.*, i. 27.—B. H., *Gen.*, 25, 957, n. 18.—H. Bn., *Adansonia*, viii. 328, 338.—*Rhopalocarpus* Teism. & Binnend., ex Miq., *Ann. Mus. Lugd. Bat.*, ii. 22, t. 2 (nec Boj.).

[6] The outer petals are sometimes membranous like the sepals, as is seen in *A. prinoides* A. S. H.

variable number of stamens inserted in a spiral, either all fertile, consisting of an elongated or lanceolate blade, to the outer face of which are applied the two parallel anther-cells, or else the innermost sterile and reduced to imbricated petaloid staminodes (fig. 241).[1] The carpels are indefinite: each ovary, surmounted by a style of



Anaxagorea acuminata.

Fig. 241. Diagram.

Fig. 242. Fruit dehiscing ($\frac{2}{1}$).

variable length,[2] encloses two ovules inserted on the inner angle at a variable distance from its base;[3] they are ascending, with the micropyle external. The fruit consists of a variable number of follicles that open along the inner edge (fig. 242). They often end in a point and taper into a long foot at the base; and contain one or two smooth seeds,[4] in which the embryo occupies the apex of

(*Xylopia prinoides* Dun., *Mon.*, 122, t. 15) and *javanica* Bl. But the inner petals of the former species are thicker and more fleshy, with valvate, slightly bevelled edges. In some American species the thickness of the corolla becomes considerable. That of *A. acuminata* A. S. H. (*A. brevipes* Spruce) especially has the inner petals very much developed, coriaceous, and as thick as they are broad towards the summit. Towards the base of each is a deep hollow on the inner face which contributes to form a chamber for the sexual organs, thus assuming nearly the shape of a *sabot*; but this face is flat above, where the transverse section of the petal is nearly an equilateral triangle. In *Rhodocarpus* on the contrary the inner petals are thinner and narrower than the outer ones; but these points of dissimilarity are not of generic importance.

[1] It is just on the presence or absence of these that are founded the subgenera *Anaxanthus* and *Agoranthus*, the former having all its stamens fertile, and the latter "*Stamina intima elongata, apice torta, antheris parvis effœtis.*" But those are wrong who with Endlicher (*loc. cit.*) would limit this latter section to the Asiatic species; for *A. acuminata* A. S. H. has well developed petaloid staminodes within the fertile stamens; they are oblong flattened imbricated blades.

[2] It is sometimes narrow and elongated, sometimes swollen, or bent like a plume, and covered with stigmatic papillæ over the whole of the convex surface.

[3] Those of *A. prinoides* are nearly collateral and basilar; those of *A. acuminata* are placed one above the other, nearly half way up the inner angle.

[4] When there are two they are closely applied to each other over a large plane surface. When there is but one seed, both its faces are convex.

the slightly ruminated albumen. The genus *Anaxagorea* consists of trees or shrubs, of which half a dozen species are known, divided between tropical Asia[1] and tropical America.[2] The leaves are of very variable consistency;[3] and in their axils are the flowers, solitary, or in two- or few-flowered cymes.[4] We may define *Anaxagorea* as *Unona* with dehiscent fruits.

Disepalum,[5] possesses a perianth with dimerous verticils, with the sexual organs of a *Unona* of the section *Polyalthia*, to which it bears the same relation as *Tetrapetalum* does to *Uvaria*. The calyx consists of two valvate sepals. The four petals are narrow, linear-spathulate, bent, and inclining inwards at the apex, while the bases are joined by a sort of common ring; the only known species of this genus is *D. anomalum*,[6] a shrub from Borneo with alternate thick feather-veined leaves, and solitary terminal flowers on long peduncles.

Bocagea[7] may be considered as *Unona*, with small flowers, but with the stamens of the *Miliuseæ*. Its characters are, on the whole, those of *Unona*: a gamosepalous calyx[8] of three divisions, and a corolla of six valvate petals, which are sometimes those of a true *Unona*, sometimes those of certain species of *Polyalthia*, *Melodorum*, or *Trigyneia*.[9] Sometimes the contraction seen at the base of the inner petals becomes so marked that this corolla, though less elevated, becomes very like that of several *Mitrephoreæ*. In about half the Indian species of this genus, which have been termed *Alphonsea*, the carpels and stamens are very numerous.[10] The former

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[1] WALP., *Rep.* i. 80; *Ann.* iv. 72; vii. 55.—MIQ., *Fl. Ind.-Bat.*, i., p. ii. 49; *Ann. Mus. Lugd. Bat.*, ii. 22, t. 2.

[2] BENTH., *Hook. Journ.*, v. 8; *Journ. Linn. Soc.*, v. 71.—MART., *Fl. Bras. Anonac.*, 40, t. 5.

[3] Those of most American species, except *A. prinoides*, become very thick and coriaceous.

[4] They may be slightly extra-axillary. Those of *A. acuminata* sometimes form a uniparous two-flowered cyme, the two flowers, which are close together, being of different generations.

[5] HOOK. F., *Linn. Trans.*, xxiii. 156.—B. H., *Gen.*, 25, n. 16.

[6] HOOK. F., *loc. cit.*, t. 20.

[7] A. S. H., *Flor. Bras. Mer.*, i. 41, t. 9.—A. DC., *Mém.*, 39.—SPACH, *Suit. à Buff.*, vii. 514.—MART., *Fl. Bras.*, *Anonac.*, 44, t. 14.—ENDL., *Gen.*, n. 4709.—B. H., *Gen.*, 29, n. 39 (ex part.).—H. BN., *Adansonia*, viii. 163, 338.—*Alphonsea* HOOK. F. & THOMS., *Fl. Ind.*, i. 152.—B. H., *Gen.* 29, n. 37.

[8] That of *B. verrucosa* (*Alphonsea verrucosa* HOOK. & THOMS., ex THW.) is like a triangle with blunted angles and without any depression on the edges. That of *B. alba* A. S. H. (*loc. cit.*) is a cupuliform sac with only three short teeth on the edge. In *B. viridis* A. S. H., it is an equilateral triangle with the vertices not blunt. In *B. heterantha* H. BN. (*Adansonia*, viii. 173), and *lutea*, HOOK. & TH. (*Fl. Ind.*, i. 153), the sepals, united at the base, are separated from one another by three deep clefts.

[9] In *B. alba* A. S. H., those of the outer corolla are oval-acute, and the inner ones are similar at the apex, but hollowed out on each side near the base. In *B. viridis* A. S. H. they are all similar, concave and oval, as they are in *B. verrucosa* and *canescens*. In *B. multiflora* the claws of the inner petals are hardly indicated.

[10] Their number is indefinite in *Alphonsea lutea* and *ventricosa*, and in *Uvaria Badajamba* ROXB. (which appears identical with *B. ventricosa*), plants all of which we refer to the genus *Bocagea*. But we shall see that in other species of *Alphonsea* the number of carpels is but small though the stamens may be very numerous.

have multiovulate ovaries; the latter are in a variable number of rows, and the connective is prolonged above the extrorse anther into an obtuse projection of variable length, narrower than the anther itself (fig. 250). The stamens are shorter as they are more external. But this genus presents remarkable examples of reduction in the numbers of all the parts of the flower, and we shall see how we gradually arrive at certain species in which all the floral whorls are

Bocagea heterantha.

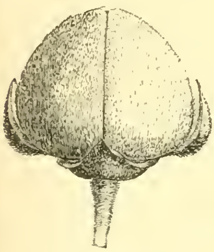

FIG. 243.
Flower-bud ($\frac{8}{1}$).

FIG. 244.
Flower, the outer petals removed.

FIG. 245.
Longitudinal section of flower.

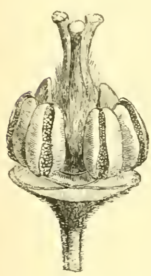

FIG. 246.
Triandrous flower, perianth removed.

FIG. 247.
Diagram.

only trimerous, while each ovary contains but one ovule; and that, without its being possible to found distinct generic sections in this small group, because the transitions between the species are all so perfectly gradual.

Thus *B. verrucosa*,[1] with numerous stamens, has no more than three or four pluriovulate carpels. *B. multiflora*,[2] a Brazilian species, has indefinite carpels; but each contains only three or four

[1] The stamens are usually from twelve to fifteen in number. The petals are nearly all equal, and the calyx is like a small equilateral triangle with blunt vertices. The inner stamens are much the longer, and stick to the feet of the carpels. These are free, but their dilated stigmatiferous heads are glued together to form a thick mass. There are usually eight ovules in each carpel. The floral receptacle is hardly convex.

[2] MART., *loc. cit.*, t. 14.—H. BN., *Adansonia*, viii. 164.—*Guatteria multiflora* PŒPP.,

ascending ovules. In the two first-known species of this genus, *B. alba*[1] and *viridis*,[2] both from the same country, the carpels are pluriovulate, but there are only three of them, while there are no more than six stamens. Finally, of the small flowers of *B. heterantha*[3] (figs. 243–247), which grows in the islands to the east of Africa, some have also six stamens, of which three, the shorter ones, are superposed to the interior petals. But in other flowers these three are completely lost. Thus they only possess a calyx of three divisions, three outer petals, three inner ones contracted at the base, the three stamens answering to the outer petals, at the same time that the gynæceum is reduced to three carpels, usually uniovulate; so that these flowers present us with the greatest degree of simplification as yet met with among *Anonaceæ*.

Moreover, in this group, as in many others of the same order, without any diminution of the number of pieces of the androceum, those of the gynæceum may be reduced to a single one. This does not appear constant in *B. canescens*;[4] for the single biovulate ovary observed in some of them is inserted laterally, on one side of the receptacle, while the place for the other carpels remains unoccupied. In *B. Gaudichaudiana*[5] (figs. 248–250), which we have made the type of a particular section,[6] the ovary of the single carpel forming the gynæceum is apparently terminal, which would seem to indicate that it has been solitary the whole of its existence. Its ovules are

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Herb., n. 2668. In this species we have demonstrated that there are often more than twelve stamens, and from ten to twelve or fifteen carpels. There are some carpels with two ovules, and others containing as many as four. The æstivation of the corolla is certainly valvate. The inflorescence usually springs from a sort of excrescence on the wood of an old branch, whence arise flowers of many successive generations.

[1] A.S.H., *loc. cit.* The stamens are here six in number, as in the following species. The anther-cells are linear adnate, and almost marginal.

[2] A.S.H., *loc. cit.*, t. 9. Here the carpels are superposed to the outer petals. The inflorescence of this species presents remarkable peculiarities (see *Adansonia*, viii. 161).

[3] H. Bn., *Adansonia*, viii. 173. The very small flowers of this species are borne on very long capillary peduncles. The carpels, supported on little slender feet, rarely contain two ovules. We have seen that the inner corolla of this species is already in some respects that of the *Mitrephoreæ*. Nevertheless, it is inseparable from the Old World *Alphonseas*.

[4] Spruce, *exs.*, n. 3549.—H. Bn., *Adansonia*, viii. 171.—*Trigyneia ? canescens* Benth., *Journ. Linn. Soc.*, v. 70. In this species the petals are all similar, short and concave. The calyx is gamosepalous, with its three angles not prominent. The stamens may be as many as fifteen in number, and are pretty regularly arranged on the receptacle. The short filament is surmounted by a large fleshy body like an elongated cone, to the sides of which are applied the two anther-cells close to the base. The ovary is surmounted by a short reflexed style. On the sides of the receptacle we see the places for the aborted carpels.

[5] H. Bn., *Adansonia*, viii. 183.

[6] Sect. *Eremodelphis* (See *Adansonia*, *loc. cit.*). Bentham & Hooker (*Gen.*, 21), had already pointed out an *Alphonsea* with a unicarpellary gynæceum. There is no reason to separate generically the species in which this occurs; for in other generic groups there are

numerous, in two vertical rows; and the receptacle which it terminates gives insertion below to a large number of stamens, which are shorter as they are more external, and to two thick valvate corollas, forming in the bud the sort of three-sided pyramid of certain species of *Melodorum* and *Kentia*.

Thus constituted,[1] the genus *Bocagea* includes half a score species from the tropical regions of both hemispheres. We already know

Bocagea (Eremodelphis) Gaudichaudiana.

FIG. 248.
Flower.

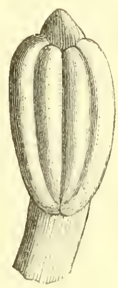

FIG. 250.
Stamen.

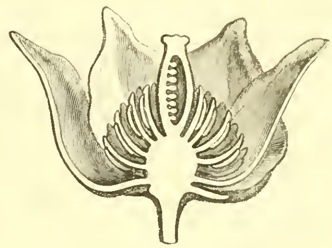

FIG. 249.
Longitudinal section of flower.

five species from Brazil[2] and one from Ambongo.[3] The others are Indian plants, hitherto described under the name of *Alphonsea*.[4] They are trees or shrubs, with alternate, often glabrous, leaves. The flowers are either solitary or grouped into few-flowered cymes, often supported on slender peduncles; sometimes axillary, sometimes terminal, but more often leaf-opposed or extra-axillary, springing from the branches at very variable heights on the internodes; and this variation may occur in one and the same species.

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at the same time pluri- and uni-carpellary plants. Here the gynæceum is inserted near the summit of a rather elongated floral receptacle. The ovules are numerous, arranged in two vertical rows; and the style is somewhat swollen at its apex into a depressed stigmatiferous head. The structure of the very numerous stamens, which are shorter as they are more external, is the same as in *B. verrucosa*.

[1] Namely, first of the Indian *Alphonseas*, which might become a section if we only retained the species that are pluri-carpellary, and have many stamens. A second section might be formed for the Old World species with only a limited number of stamens, especially *B. heterantha*, which has but three or six. In a third section, which would bear the same relation to the rest of the genus as *Monocarpia* bears to *Unona* proper, the gynæceum would be reduced to a single carpel (*Eremodelphis*). Finally the true *Bocageas*, all American, would have the stamens and carpels definite or nearly so; but the latter would be multiovulate as in the species for which A. DE SAINT-HILAIRE established the genus; or else, as in *B. canescens*, a single excentric carpel with a biovulate ovary would exist in the centre of the flower.

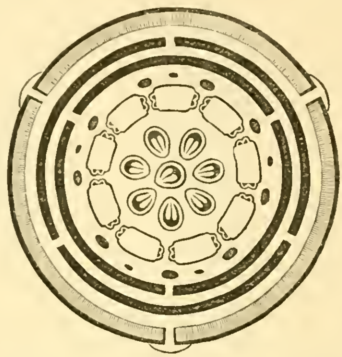
[2] A. S. H., *loc. cit.* (see p. 210, notes 1, 2).—MART., *Fl. Bras.*, 44, t. 14.—H. BN., *Adansonia*, viii. 164, 169, 170.

[3] H. BN., *Adansonia*, viii. 173.

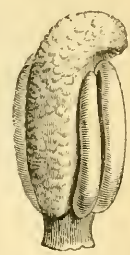
[4] HOOK. & THOMS., *Fl. Ind.*, i. 152.—THW., *Enum. Pl. Zeyl.*, 11.

While we may define *Bocagea* as *Unona* with the stamens of *Miliusa*, *Popowia*[1] (figs. 251–260), closely analogous by the small size of its flowers and by its corolla and gynæceum, has most peculiar stamens, very dissimilar in the fairly numerous species now included in the genus, and which, presenting in some species forms like those ascribed to the *Uvarieæ* and the *Miliuseæ*, offer, on the contrary, in others, very strange forms, which would necessitate the foundation of a special tribe, if it were always right to set a

Popowia caffra.
Fig. 251.
Stamen ($\frac{15}{1}$).



Popowia (*Clathrospermum*) *Mannii.*
Fig. 252.
Diagram.



Popowia fornicata.
Fig. 253.
Stamen ($\frac{15}{1}$).

capital value on the appearance of the pieces of the androceum. But this will only be seen after a somewhat detailed study of certain African species of *Popowia*.

P. caffra,[2] for instance, has a small flower, of which the bud is depressed, with a short calyx of three divisions, and six valvate petals, nearly as broad as they are long. The outer ones are sessile, nearly triangular. The inner taper considerably at the base, where they leave large openings between one another, through which the stamens are seen. These are rather numerous. The inner ones are the longer, and touch by their very thick edges, to form a continuous circular belt round the gynæceum. The outer ones are the shorter, but all present the same conformation, easier to represent (fig. 251) than to describe. Imagine an

[1] Endl., *Gen.*, n. 4710.—B. H., *Gen.*, 25, n. 19.—H. Bn., *Adansonia*, viii. 314, 339.—Hook. & Thoms., *Fl. Ind.*, i. 114.

[2] Benth., *Linn. Trans.*, xxiii. 170, n. 1. (The species n. 2 of this author is a *Cleistochlamys*).—*Guatteria caffra* Sond., *Fl. Cap.*, i. 9.—*Unona caffra* E. Mey., *Pl. Dreg.*

inverted truncated pyramid, whose larger base slants very obliquely downwards and inwards, and is terminated above and internally by a sort of beak, here still short and obtuse, but which we shall see becomes far more marked in several of its congeners. The surface of part of the connective is covered with warty, glandular, finely-mammillated projections ; on the sides, and somewhat externally, are the two anther-cells, which dehisce longitudinally. The gynæceum consists of a variable number of carpels. Each ovary contains one or two nearly basilar ascending ovules, whose micropyle looks downwards and outwards. The style is club-shaped, slightly bent, and obtuse at the tip. The fruit is multiple, composed of a variable number of stipitate one-seeded berries.

Several other species from the same country are now known,[1] of the same general structure, and only distinguished from the last by the somewhat variable number of stamens. The outermost may disappear, when the androceum will appear to consist of a single whorl, or in others the outer stamens are not quite absent, but become sterile (fig. 252). The gynæceum does not always contain the same number of ovules. Certain species have only one in each ovary, while others contain a variable number inserted along the inner angle in two vertical rows. Hence the fruits are not always one-seeded, sometimes forming chaplets like those of *Unona* proper. As for the perianth, its form is very variable. The bud may be elongated and ovoidal, and the inner petals, more contracted at the base, form a corolla like that of several *Mitrephoreæ*, except that the claws are less elongated. But the character which varies most from one species to another is the form of the stamens. The projection of the connective, the size and direction of the sort of oblique beak surmounting it internally, the thickness of its upper part, the glandular mammillated state of its surface, and finally, the lengthened obliquity of the anther cells—these are the features that are almost always clearly changed in passing from one species to another, and that often become peculiarly marked in the plants we are now about to consider.

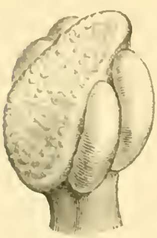
Uvaria ? Vogelii HOOK. F.[2] has become the type of a genus, *Clathrospermum*,[3] which might have appeared perfectly distinct when but

[1] See *Adansonia*, viii. 316–326.

[2] *Niger*, 208, t. xvii.

[3] PLANCH. & HOOK. F., *loc. cit.*—B. H., *Gen.*, 29, 958, n. 38.—BENTH., *Linn. Trans.*, xxiii.

very few African *Anonaceæ* were known, but which is now linked to *Popowia caffra* and its neighbours by a large number of intermediate species. The flowers of *C. Vogelii*, in form and size analogous to those of certain species of *Bocagea*, or of the sections *Polyalthia* and *Kentia* of *Unona*, have a slightly convex receptacle, a short gamosepalous calyx, scarcely marked by three crenulations, three outer petals, triangular sessile and valvate; three inner ones somewhat shorter, valvate above, and not touching one another by their contracted bases. The stamens, from six to ten in number, are collected into a sort of crown around the gynæceum. Their form is singular (fig. 254); each, as in *Popowia caffra*, is a truncated pyramid with the large base upwards, very oblique, continuous with the connective, and like it covered with a sort of irregular glandular tissue On its sides, which in the bud touch those of the two neighbouring stamens, and as it were stick to them, we see the two anther-cells, somewhat oblique, each dehiscing by a longitudinal cleft between the two half-cells, one of which is placed a little higher than the other. The gynæceum, consisting of about half a dozen carpels, is similar to that of *P. caffra*, each ovary containing several ascending ovules.



Popowia (*Clathrospermum*) *Vogelii.*
FIG. 254.
Stamen ($\frac{18}{1}$).

Here, as in *Popowia* proper, the stamen gradually alters in form from one species to another. The size and obliquity of the anther vary; either its cells are quite thrown back to each side,or they approach each other towards the outer face of the anther. This is continuous, without any appreciable line of demarcation, with the filament, which, short and thick in certain species, such as *P. caffra* or *fornicata*[1] (figs. 251, 253), becomes elongated and tapers towards the base in others, especially *P. Vogelii* (fig. 254). The superior base of the sort of pyramid to which we have compared the connective becoming less and less oblique convex, finally, in *P. Heudeloti*[2] (fig. 255), has a nearly horizontal direction and is slightly concave. In *P. Barteri*,[3] the sort

Popowia (*Clathrospermum*) *Heudeloti.*
FIG. 255.
Stamen ($\frac{12}{1}$).

479.—H. Bn., *Adansonia*, viii. 315.—Oliv., *Fl. Trop. Afric.*, 24.

[1] H. Bn., *op. cit.*, 318.

[2] H. Bn., *op. cit.*, 320, note 2 (see the text for th complicated details of the forms of the stamens)

[3] H. Bn., *op. cit.*, 321.

of internal horn, which remained obtuse in the other species, is flattened out and elongates inwards so much (fig. 260) that the union of all the stamens forms a sort of chamber around the gynæceum, covered in by a nearly flat roof, only perforated in the centre to give passage to the tops of the styles (fig. 258). The number of stamens is not the same in all the species, and the apparently verticillate arrangement of the fertile stamens does not prevent the presence of

Popowia (*Clathrospermum*) *Barteri.*

FIG. 256.
Flower-bud ($\frac{10}{1}$).

FIG. 257.
Flower.

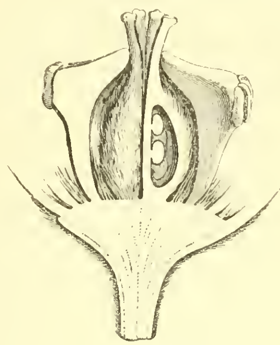


FIG. 259.
Longitudinal section of flower.

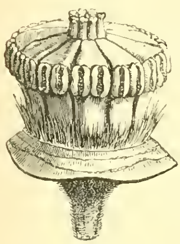


FIG. 258.
Flower, perianth removed.

FIG. 260.
Stamens.

a certain number of external staminodes arranged with some degree of symmetry (fig. 252), and representing the shortest stamens observed in *P. caffra.* As for the gynæceum and fruit, they present every possible variation in the number and position of the ovules and seeds, from a solitary erect ovule to a pretty large number in two parallel rows, from the one-seeded berries of *P. caffra* and *P. Vogelii* to the chaplet-like fruits of *P. Heudeloti* and the allied species.[1]

As known to us, this genus at present consists of about fifteen

[1] In an African plant ascribed to this genus by BENTHAM & HOOKER (*Gen.*, 958) the flowers are diœcious, and the carpels are about sixty in number. If this is really the species of Mr. MANN's collection (which we have analysed, and for which a new genus should perhaps be established), its outer petals are alone well developed, the inner ones being represented by very minute obtuse scales, and the ovaries are each surmounted by an ovoidal stigma, and contain at least six ovules. (See OLIVER, *loc. cit.*, n. 2.)

species. Ten come from tropical and southern Africa[1] and Madagascar or the neighbouring islands.[2] The rest come from India and the Indian Archipelago,[3] except one observed in Australia.[4] They are small trees or shrubs, with alternate leaves, and flowers solitary or collected into cymes or clusters of cymes, sometimes axillary or lateral, sometimes terminal or leaf-opposed.

C. Xylopieæ.—In *Xylopia*[5] (figs. 261–266) the flowers are regular and hermaphrodite. The calyx is very short, gamosepalous, trifid to

Xylopia æthiopica.
Fig. 261.

a variable depth, and valvate in æstivation. The corolla consists of six petals, whose conformation is often so peculiar that they, and

[1] Hook., *Niger*, 208.—Benth., *loc. cit.*, 470–479.

[2] H. Bn., *loc. cit.* (see p. 214, notes 1–3).

[3] Hook. & Thoms., *op. cit.*, 105.—Bl., *Fl. Jav., Anonac.*, t. 45.—Miq., *Fl. Ind.*, i. p. ii. 27; *Ann. Mus. Lugd. Bat.*, ii. 20.—Walp., *Ann.*, iv. 51; vii. 55.

[4] Benth., *Fl. Austral.*, i. 52.

[5] L., *Gen.*, n. 1027.—Juss., *Gen.*, 284.—Gærtn., *Fruct.*, i. 399, t. 69.—Dun., *Mon.*, 121.—DC., *Syst.*, i. 499; *Prodr.*, i. 92.—A. DC., *Mém.*, 33.—Spach, *Suit. à Buffon*, vii. 506.—Endl., *Gen.*, n. 4714.—B. H., *Gen.*, 28, 958, n. 32.—H. Bn., *Adansonia*, iv. 140; viii. 202, 330, 340.—*Embira* Pis., *Brasil.*, 71.—*Pindaiba* Pis., *loc. cit.*—*Ibira* Marcg., *Brasil.*, 90.—

petals resembling them, have been termed "petals of the *Xylopieæ*."[1] The outer ones, alternate with the divisions of the calyx, are a little larger than the inner ones, and are narrow and elongated, concave only near the base, where each is marked internally by a little pit; above this they are thick, tapering, often connivent into an acute cone or pyramid, or more rarely spreading after the expansion of the flower[2] (figs. 262, 263). The interior petals, of nearly the same form, have the

Xylopia grandiflora.

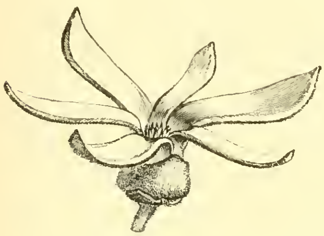


FIG. 262.
Expanded flower.

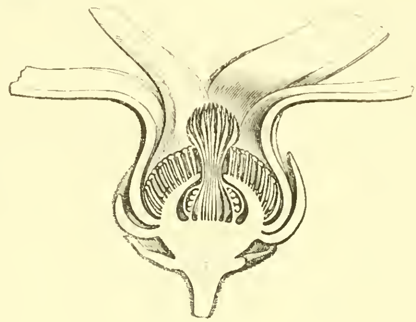


FIG. 263.
Longitudinal section of flower.

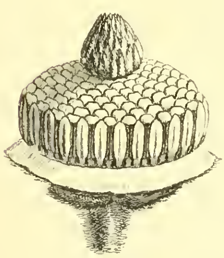


FIG. 264.
Flower, perianth removed.

FIG. 265.
Seed.

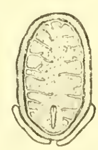


FIG. 266.
Longitudinal section of seed.

basilar pit moulded on the convexity of the androceum, above which they become triquetrous, and are united to one another by a large

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Bulliarda NECK., *Elem.*, n. 1103 (nec DC.).—*Xylopicron* P. BR., *Jam.*, 250.—*Waria* AUBL., *Guian.*, 604, t. 243.—*Habzelia* A. DC., *Mém.*, 31.—ENDL., *Gen.*, n. 4715.—*Cœlocline* A. DC., *op. cit.*, 32.—ENDL., *Gen.* n. 4716.—*Patonia* WIGHT, *Ill.* i. 18.—*Habzelia* HOOK. & THOMS., *Fl. Ind.*, i. 123.—B. H., *Gen.*, 28, n. 33 (nec A. DC.).—*Parartabotrys* B. H., *Gen.*, *loc. cit.* (nec MIQ.).

[1] "*Petala exteriora crassa, conniventia v. vix aperta; interiora inclusa minora.*" B. H., *Gen.*, 22.

[2] In most flowers the petals, cohering into a three-sided pyramid, fall altogether when they become detached at the base. But it is certain that this is not always the case, and that they may expand spontaneously when the flower opens, as occurs in *X. æthiopica*, where their summits alone diverge (fig. 261), and in certain other species where they become free to the base. In some species the form of the corolla is far nearer that of the *Unoneæ*. We shall see below that in the species of the section *Pseudanona* there is also an abnormality in the structure of the corolla.

surface to form a three-sided pyramid. Above the perianth the receptacle usually undergoes a singular deformation. Its centre is in most species much depressed into a sort of conical sac, while its borders rise up considerably, projecting above this sac to form a sort of roof or dome, leaving only a very narrow aperture at the summit (fig. 263). This is traversed by the styles, which project from it, while the ovaries are lodged within the receptacular sac, the whole of whose convex surface gives insertion to the pieces of the androceum, which are arranged in a spiral (fig. 264). The stamens, articulated at the base and very caducous, consist of a flattened connective, swollen at the apex into a truncate or rounded glandular head, and bearing on its outer face two adnate cells of longitudinal dehiscence. The carpels, of variable number,[1] consist each of an ovary tapering into a style, which is dilated[2] after passing through the orifice of the receptacular dome (fig. 263), and then tapers again into a stigmatiferous apex. In the interior angle of the ovary is seen a placenta bearing an indefinite number of ovules, originally arranged in two vertical rows, with their micropyles turned outwards and downwards; more rarely their number is reduced to two or three, inserted at variable heights on the interior angle of the ovary. The compound fruit consists of a variable number of sessile or slightly stipitate berries, more or less elongated, or short and thick, with or without more or less marked strangulations between the individual seeds.[3] They sometimes open more or less irregularly; the seeds contain a ruminated albumen and a minute embryo. The aril is often well developed on both sides of the umbilicus (figs. 265, 266).

In some species, the very peculiar form of the receptacle disappears more or less completely; the terminal part supporting the carpels

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[1] Certain flowers of *X. malayana* only contain three. *X. Lastelliana* H. Bn. (*Adansonia*, iv. 144) has usually six, each superposed to a petal. In many other species, especially *X. æthiopica* A. Rich., there are very many, as there are in the species of the section *Pseudanona*. Here and there are flowers with a single carpel.

[2] This swelling is rarely wanting. It is long and fusiform in most species, claviform in *X. malayana* Hook. & Thoms. (*Fl. Ind.*, i. 125). In *Pseudanona* the style is only a long narrow strap, more or less revolute at the apex.

[3] In *X. æthiopica* the berries are nearly continuous, presenting but very slight strangulations; they are more or less marked, sometimes even very deep in *X. Richardi* Boiv. (ex H. Bn., *Adansonia*, v. 145, n. 1), a species found in Bourbon, but which, according to A. Richard (*MSS.*), is a native of America. In the species of the section *Pseudanona* the berries are thick and nearly continuous, recalling those of *Asimina* in form and size. In *X.* (*Habzelia*) *ferruginea*, on the contrary, they are deeply strangulated, so deeply and regularly as to recall on the whole the moniliform masses of the *Unonas*, such as *U. discolor* (figs. 237, 238). The berries of *X. Vieillardi* (see p. 219, note 4) are short and irregularly obovate, often monospermous.

becomes only a shallow pit, or even a horizontal platform. These species have been made into a genus, *Habzelia*,[1] which, as all its other characters are the same, can merely be considered as a section of the genus *Xylopia*, containing only Old World species.

Again, in other species of this genus, such as *X. grandiflora* A. S. H.,[2] *lucida* H. Bn.,[3] &c., it happens that, as in many other genera of this order, the outer stamens, instead of being fertile, are converted into small petaloid scales (fig. 264).

Even the usual character of the corolla may to a great extent be wanting. In several species from tropical Asia, or the north of Oceania, the petals, all nearly similar to one another, lose much of their length and thickness. Each corolla forms only an obtuse cone; the petals are sessile, nearly triangular, and of about the same thickness from base to apex. The inner ones alone have slight lateral notches at the base, through which, as in the typical *Xylopias*, we see the pieces of the androceum. The small flowers of *X. Vieillardi*,[4] from New Caledonia, possess this conformation of the flower-bud in the highest degree—evidently a step towards the form of the corolla in certain *Unoneæ*.

Finally, two remarkable plants from the east of Africa, formerly ascribed to the genus *Anona*, must also be referred to *Xylopia* as forming a particular section to which we shall give the name of *Pseudanona*. These are *X. amplexicaulis*[5] and *Lamarckii*.[6] Their

[1] Hook. & Thoms., *Fl. Ind.*, i. 123.—B. H., *Gen.*, 28, n. 33.—Walp., *Ann.*, iv., 61.—Wall., *Cat.*, n. 6478.—Miq., *Fl. Ind.-Bat.*, i. p. ii. 37.—H. Bn., *Adansonia*, viii. 330, 340 (nec A. DC., *Mém.*, 31). *X. malayana* Hook. f. & Thoms., and some analogous species, have an acutely conical receptacle, whose apex alone is slightly hollowed to receive the base of the gynæceum; so that these species are intermediate between *Habzelia* and those species of *Xylopia* in which the receptacular sac envelopes the ovaries up to the summit.

[2] *Flor. Bras. Mer.*, i. 39, t. 8.

[3] *Adansonia*, viii. 182.—*X. longifolia* A. DC., *Mém.* 34, n. 1 (1832).—*X. cubensis* A. Rich., *Fl. Cub.*, 16, t. 6.—*X. grandiflora* Benth., *Sulph.*, 64 (nec A. S. H.).—*X. Dunaliana* Pl. & Lind., *Pl. Columb.*, 15.—*Unona lucida* DC., *Syst.*, i. 498; *Prodr.*, i. 92, n. 34.—Dun., *Mon.* (1817), 116, t. 23.—*U. xylopioides* Dun., *op. cit.*, 117, t. 24.—*Cœlocline ? lucida* A. DC., *op. cit.*, 33, n. 5.

[4] H. Bn., *Adansonia*, viii. 202.

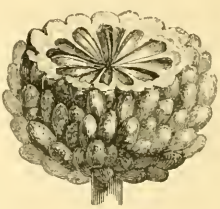
[5] H. Bn., *Adansonia*, v. 112, n. 1.—*Anona amplexicaulis* Lamk., *Dict.*, ii. 127.—DC., *Prodr.*, i. 86, n. 22.—Dun., *Mon.*, 76, t. 7. In this species, not only are the carpels and the ovules in each ovary numerous, and the styles linear, but the petals have also a quite peculiar configuration. The inner set form a small acute triquetrous corolla. The outer ones, far broader and longer, and quite different in form, are oblong-lanceolate, subspathulate, with the inner faces very narrow and acute, moulded on the convexity of the inner corolla, and corresponding exactly with its form; their edges are very thick, and are in contact for a breadth of nearly a centimetre.

[6] H. Bn., *loc. cit.*, n. 2.—*Anona grandiflora* Lamk., *loc. cit.*—DC., *loc. cit.*, n. 21.—Dun., *op. cit.*, 75, t. 6. Here the buds are much more rounded and obtuse at the apex than in the preceding species. The outer petals are of nearly the same form as the inner ones, but a little broader and longer. They increase in size towards the upper extremity, where they are spoon-

corollas are in fact similar to those of several American *Anonas* in the breadth of the petals and the thickness of their edges; while their ripe carpels are, as we have seen, as thick as in several species of *Unona*; their number is considerable in the flower, and much reduced in the fruit.

Thus constituted, the genus *Xylopia* contains about thirty species from the warm regions of Africa,[1] Asia,[2] and Oceania,[3] while about fifteen come from tropical America.[4] They are trees or shrubs, with flowers solitary or cymose, axillary or lateral, rarely terminal.

The genus *Anona* (figs. 267–274)[5], which has given its name to the whole order, and to which nearly all its species were at first



Anona squamosa.

FIG. 267. Fruit ($\frac{1}{4}$).

FIG. 268. Transverse section of fruit.

referred, may be defined in few words, now that we know the preceding genus: *Anona* is *Xylopia* with a convex receptacle whose pauci-ovulate ovaries become a fleshy multiple fruit with connate carpels (figs. 267, 268, 271); or, again, *Anona* is to *Xylopia* what *Duguetia* is, on the whole, to *Uvaria*. The calyx consists of three sepals,

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shaped, concave within and bowed at the apex, and where they only touch by a rather thin edge, not by a very broad surface. In fact, as in *X. Vieillardi*, they are nearly the petals of *Unona*.

[1] HOOK., *Niger*, 204.—BENTH., *Linn. Trans.*, xxiii. 478.—A. DC., *Mém.*, 31–34.—RICH., GUILL., PERR., *Tent. Fl. Seneg.*, i. 9.—H. BN., *Adansonia*, iv. 140; v. 362.

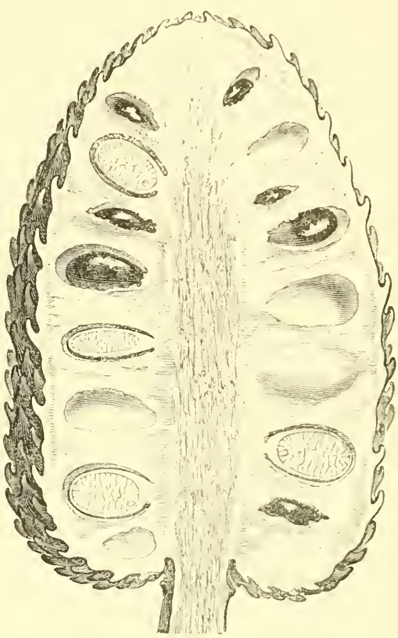
[2] HOOK. & THOMS., *Fl. Ind.*, i. 123.—THW., *Enum. Pl. Zeyl.*, 9.

[3] ZOLL., *Linnæa*, xxix. 318.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 37; *Ann. Mus. Lugd. Bat.*, ii. 43.

[4] A. S. H., *Fl. Bras. Mer.*, i. 39, t. 8.—A. RICH., *Fl. Cub.*, 15, t. vi. vii.—MART., *Fl. Bras.*, *Anonac.*, 41, t. 13.—GRISEB., *Fl. Brit. W. Ind.*, 6.—SCHLTL., *Linnæa*, ix. 326.—PL. & TRIANA, *Ann. Sc. Nat.*, sér. 4, xvii. 37. Also, for the species of different countries, WALP., *Rep.*, i. 75; *Ann.*, iv. 61; vii. 59.

[5] *Anona* L., *Gen.*, n. 693 (*Annona*).—JUSS., *Gen.*, 283.—GÆRTNER, *Fruct.*, ii. 193, t. 138.—DUN., *Mon.*, 28, 58, t. 2–7.—DC., *Syst.*, i. 466; *Prodr.*, i. 83; ap. DELESS., *Icon. Sel.*, i. t. 86.—SPACH, *Suit. à Buffon*, vii. 497.—ENDL., *Gen.*, n. 4723.—WALP., *Rep.*, i. 86; ii. 748; v. 15; *Ann.*, ii. 20; iv. 56; vii 58.—*Bot. Reg.*, t. 1328.—*Bot. Mag.*, t. 2011, 2911, 2912, 3095, 4226.—B. H., *Gen.*, 27, 958, n. 30.—H. BN., *Adansonia*, viii. 265, 296, 340, 389.—*Guanabanus* PLUM., *Nov. Gen. Amer.*, 43.

free or cohering to a variable extent, valvate in æstivation. The corolla consists of six petals, that may be narrow, acute, and thick, as in most species of *Xylopia;* a character found in the highest degree in some American species, as *A. Liebmanniana,*[1] *quinduensis,*[2] &c. In others, such as *A. Cherimolia, cherimolioides, reticulata, squamosa,* &c., the corolla, less elongated and acute in the bud, comes nearer that



Anona muricata.

FIG. 269.
Flower.

FIG. 271.
Longitudinal section of fruit ($\frac{1}{2}$).

of several species of *Melodorum.* In others, again, the bud is ovoidal and more or less trigonous, as in *A. sericea, Pisonis, cornifolia, coriacea,* &c., or globular, as in different forms of *A. senegalensis,* or even depressed and of greater breadth than height, as in *A. tenuifolia* (*fagifolia*).[3] In several species the inner petals become much shorter than the outer ones, and are only represented by very short spoon-shaped scales; and in some others they finally disappear entirely.[4] But despite

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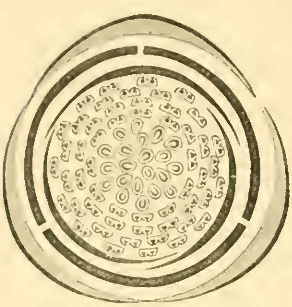
[1] H. Bn., *Adansonia,* viii. 266, n. 4.

[2] H. B. K., *Nov. Gen. et Spec.,* v. 47, n. 12.

[3] See *Adansonia,* viii. 296, where the intermediate forms observed in many other species of this genus are reviewed more in detail.

[4] On these characters DE MARTIUS (*Fl. Bras., Anonac.,* 3, 46) has founded a division of the genus *Anona* into two sections: 1st, *Guanabani,* in which the flowers have six well-developed petals; 2nd, *Atta,* where the inner petals are

all these differences of form, the petals are still very thick and valvate in the bud. In *A. muricata*[1] (figs. 269–271), while the outer petals retain these characters, the inner ones are thinner towards the edges, and are strongly imbricated in æstivation. The same occurs in *A. involucrata*,[2] in which, moreover, the flower is enveloped by two bracts, that form a complete sac for the young bud. In all these species the stamens, inserted in a spiral on a hemispherical receptacle, are surmounted by a thick, truncate, oblong or oval dilatation of the connective, and are, in a word, analogous to those of *Uvaria*. Each carpel contains one or two[3] nearly basilar ascending ovules, with the micropyles outwards and downwards; and the multiple fruit is a fleshy berry in which the seeds are scattered, and whose surface is nearly smooth, reticulate, or covered with obtuse projections or recurved prickles.



Anona muricata.
FIG. 270.
Diagram.

In one small-flowered species from Mexico, the characters of the female organs and the fruit are the same; but the flowers, few in number, have in the bud the globular form found in most *Bocageas*; hence the name of the species, *A. globiflora*;[4] the stamens are exactly those of several species of the same genus *Bocagea*, the anther-cells being surmounted by a narrow conical projection of the connective (fig. 274). The inner petals are quite wanting in this species (fig. 273). It is, however, impossible to separate this plant from the genus *Anona*, of which it constitutes a distinct section under the name of *Anonella*.

Half a hundred species of *Anona* are admitted; but this number

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wanting or reduced to small scales. These might be further subdivided according to the prefloration of the corolla, and the very different modifications of form that it affects in the bud, of which we have just spoken.

[1] L., *Spec.*, 756.—JACQ., *Obs.*, i. 10, t. 5.—DUN., *Mon.*, 62.—DC., *Syst.*, i. 467; *Prodr.*, i. 84, n. 1.—*A. asiatica* L., *Spec.* ii. 758, ex R. BR., *Congo*, 6.

[2] H. BN., *Adansonia*, viii. 265, n. 2.

[3] We have often seen two young seeds in each carpel in some newly-formed fruits of *A. squamosa*, sent from Bourbon. They were of the same size, or else the one had already greatly surpassed the other in size, whose development seemed destined to cease at that stage. This fact perhaps indicates that two is the original number of the ovules in the young carpels of *Anona*. Those we have seen in pairs were inserted at nearly the same height. The circumference of the umbilicus formed a circular projection around the insertion of the very short and relatively narrow funicle.

[4] SCHLTL., *Linnæa*, ix. 235.—H. BN., *Adansonia*, viii. 266, 313.

will probably have to be reduced. Nearly all are of American origin,[1] but some are found in tropical Asia[2] and Africa.[3] They are trees or

Anona (Anonella) globiflora.

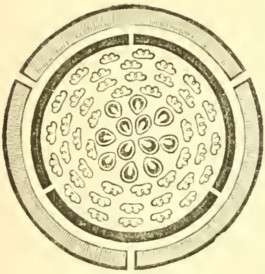

FIG. 273.
Diagram.

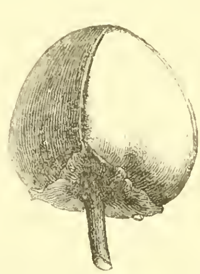

FIG. 272.
Flower-bud ($\frac{5}{1}$).

FIG. 274.
Stamen.

shrubs with alternate exstipulate leaves. The flowers are almost always solitary, usually terminal, or leaf-opposed, or lateral.

Rollinia mucosa.

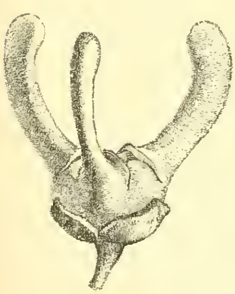

FIG. 275.
Flower.

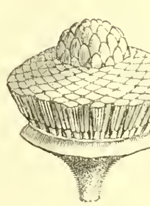

FIG. 277.
Flower, perianth removed.

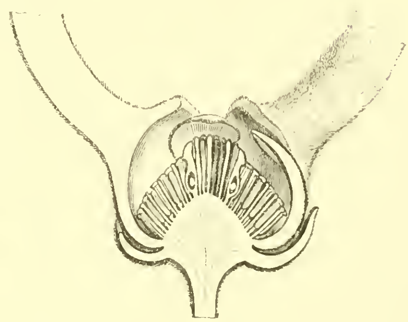

FIG. 276.
Longitudinal section of flower.

D. ROLLINIEÆ.—In *Rollinia*[4] (figs. 275–277), the flowers are, as

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[1] AUBL., *Guian.* i. 611.—PLUM., *Nov. Gen. Amer.*, 43.—H. B. K., *Nov. Gen. et Spec.*, v. 43.—JACQ., *Observ.*, i. t. 6, figs. 1, 2.—TUSS., *Fl. Antill.*, i. 194, t. 29.—A. S. H., *Pl. Us. Brasil.*, 29, 30; *Fl. Bras. Mer.*, i. 30.—SCHLTL., *Linnæa*, ix. 319.—MART., *Fl. Bras. Anonac.*, 3, t. 46.—A. S. H. & TUL., *Ann. Sc. Nat.*, sér. 2, xvii. 131.—A. RICH., *Fl. Cub.*, i. 12, t. v.—GRISEB., *Fl. Brit. W. Ind.*, 4.—PL. & TR., *Ann. Sc. Nat.*, sér 4, xvii. 25.—H. BN., *Adansonia*, viii. 265.

[2] Where they are probably introduced. See RHEEDE, *Hort. Malab.*, iii. t. 30, 31.—BL. *Fl. Jav.*, *Anonac.*, 108, t. 53.—ZOLL., *Linnæa*, xxix. 316.—WIGHT & ARN., *Prodr.*, i. 7.—ROXB., *Fl. Ind.*, ii. 657.—HOOK. & THOMS., *Fl. Ind.*, i. 115.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 33.

[3] SCHUM. & THÖNN., *Beskr.*, 257.—PERS., *Syn.*, ii. 95.—RICH., GUILL. & PERR., *Tent. Fl. Seneg.*, i. 4.—BOJ., *Ann. Sc. Nat.*, sér. 2, xx. 53.—HOOK. F., *Niger*, 204.—BENTH., *Linn. Trans.*, xxiii. 476.—H. BN., *Adansonia*, v. 362; viii. 380.—OLIV., *Fl. Trop. Afric.*, 15.

[4] A. S. H., *Flor. Bras. Mer.*, i. 28, t. 5.—SPACH, *Suit. à Buffon*, vii. 503.—ENDL., *Gen.*, n. 4724.—B. H. *Gen.*, 27, n. 29.—H. BN., *Adansonia*, viii. 310, 332, 340.

regards the gynæceum, androceum, and receptacle, formed exactly as in *Anona*, and the fleshy fruit is usually the same. They are, however, distinguished at a glance by a character, no doubt of little importance in itself, but very easy to recognise; the gamopetalous corolla has three laterally flattened horn-shaped projections. These solid spurs belong to the outer petals, which, united from the base into a short cylindrical or bulging tube, have the organic apex curtailed and incurved, so that altogether they form a vault closely applied to the reproductive organs. But lower down, the median dorsal part of each is swollen into the sort of wing of which we have spoken, and which, more or less obtuse at the apex, rises obliquely or vertically like the leg of a tripod.[1] The inner petals want this appendage; they are like the bodies of the outer petals, or much smaller, reduced to small scales, or even quite absent. The receptacle is like a depressed cone; the stamens are surmounted by a truncate dilatation of the apex of the connective; each ovary contains an ascending nearly basilar ovule; and the fruit is either nearly smooth or covered with recurved points, as in *A. muricata* or several species of *Aberemoa*.[2] The genus *Rollinia* consists of about twenty trees or shrubs found in America, from Mexico to the south of Brazil.[3] Their habit and foliage are those of *Anona*, and their flowers are terminal, leaf-opposed, or extra-axillary, solitary or grouped in few-flowered cymes.

The general arrangement of the flowers of *Rollinia* is also found in a Sumatran plant which has been named *Parartabotrys*;[4] except that the ovaries of the latter contain numerous ovules instead of a single one, and the ascending horns on the backs of the petals are nearly cylindrical, and of the same thickness in every direction. In the latter character, *Parartabotrys* justifies the name given to express its analogy

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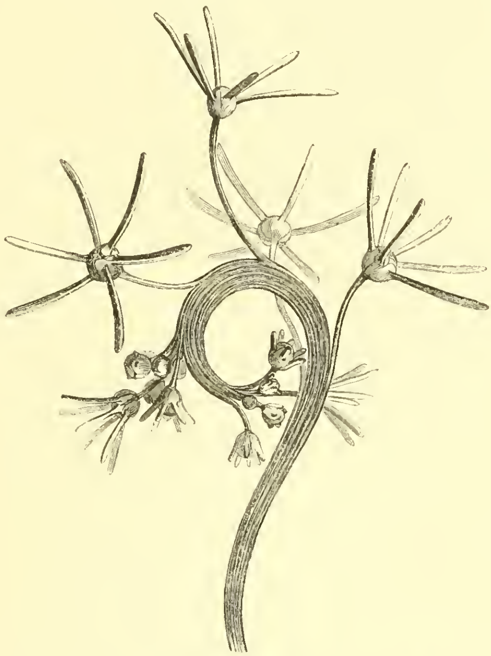
[1] Following the development of these organs in the bud, we have seen (*Adansonia*, viii. 310) that in the young buds the outer corolla is at first globular, and with the convex surface perfectly smooth. Later, a slight gibbosity arises on the middle of the dorsal median line of each petal. This it is, which becoming more marked day by day, finally produces the solid curved horn, obtuse at the apex, which all authors have remarked. It is easy to show that the true organic apex of the petal is seated far lower down than that of this solid spur.

[2] BENTHAM says (*Journ. Linn. Soc.*, v. 67) that the fruit of certain species of *Rollinia* consists of free carpels; but does not point out in which species is observed this peculiarity, which we have not been in a position to verify.

[3] A. S. H., *loc. cit.*—A. DC., *Mém.*, 23.—MART., *Fl. Bras.*, *Anonac.*, 17, 47, t. 6.—SCHLTL., *Linnæa*, ix. 314.—WALP., *Rep.*, i. 90; ii. 748; *Ann.*, ii. 20; iii. 813; iv. 57; vii. 58.—PL. & TR., *Ann. Sc. Nat.*, sér. 4, xvii. 30.—GRISEB., *Fl. Brit. W. Ind.*, 5.—H. BN., *Adansonia*, viii. 268.

[4] MIQ., *Fl. Ind.-Bat.*, suppl. i. 151; *Ann. Mus. Lugd. Bat.*, ii. 43.—H. BN., *Adansonia*, viii. 310, 329, 341.—*Xylopia* B. H., *Gen.*, 28, 958, n. 32 (nec *Auctt.*).

to certain Javanese species of *Artabotrys*,[1] such as *A. suaveolens* Bl.[2] and the species near it. In fact, we see that the flowers of these are similar in all respects to those of *Parartabotrys*, except that instead of numerous ovules we only find two in each ovary, inserted near the base of the inner angle, ascending, with their micropyles outwards and downwards. *A. suaveolens* has also a thick deeply three-lobed calyx, indefinite stamens, and a small number of carpels inserted



Artabotrys suaveolens.
Fig. 278.
Inflorescence.

on a sort of receptacular platform, surrounded by an annular projection. The fruit consists of several one- or two-seeded berries. The general structure of the flower and fruit is the same, too, in the first species of this genus that were known, such as *A. uncata*.[3] But there

[1] R. Br., *Bot. Reg.*, t. 423; *Misc. Works*, ed. Benn., ii. 685.—Spach, *Suit. à Buffon*, vii. 508. —Endl., *Gen.*, n. 4720.—B. H., *Gen.*, 24, 956, n. 10.—H. Bn., *Adansonia*, viii. 311, 341.—*Ropalopetalum* Griff., *Notul.*, iv. 716.

[2] *Fl. Jav.*, *Anonac.*, 62, t. 30, 31, D.

[3] *A. odoratissimus* R. Br., *loc. cit.*—*Uvaria uncata* Lour., *Fl. Cochinch.*, ed. Ulyssip. (1790), 349.—*U. odoratissima* Roxb., *Fl. Ind.*, ii. 666. *U. esculenta* Rottl., *Nov. Act. Soc. Nat. Cur. Berol.*, iv. 201.—*Unona uncinata* Dun., *Mon.*, 105, t. 12.—*U. hamata* Dun., *op. cit.*, 107.—*Anona hexapetala* L., *Suppl.*, 270.—*A. uncinata* Lamk., *Dict.*, ii. (1790), 127. The name *hexapetala* cannot be retained, as it would refer to all the species of *Artabotrys* indiscriminately. The names *uncata* and *uncinata* are of the same year; but we know that two years elapsed after Loureiro had communicated his memoir to the Academy of Lisbon before the first edition of it

the projections from the petals (which also cover in the sexual organs like a dome) are flattened in the radial direction of the flower, instead of being of the same breadth in every direction as in *A. suaveolens*, or laterally compressed as in most species of *Rollinia*. The genus *Artabotrys* contains about fifteen species, of which three or four come from Africa,[1] and the rest from tropical and eastern Asia,[2] or the Indian Archipelago.[3] They are shrubs, often climbers, with alternate usually smooth leaves, and flowers grouped into clusters of often few-flowered cymes. The chief axis of each cluster is flattened and dilated into a sort of recurved fasciated hook, which bears, chiefly on its convexity, groups of pedicellate flowers, whose development is often partly arrested (fig. 278).

The tree from Ceylon called *Cyathocalyx*[4] has a corolla like that of *A. uncata*, with erect blades of even more membranous texture, and only touching by the edges in the bud. But the calyx is like a deep cup, whose edges alone are incised into three teeth, and the flattened summit of the receptacle only supports a single carpel. The unilocular ovary only supports one parietal placenta, on which are inserted two rows of anatropous ovules,[5] and the style rapidly dilates into a large flattened stigmatiferous head. The fruit is a many-seeded berry. The leaves are glabrous alternate, and the flowers are solitary or grouped into few-flowered cymes, terminal or leaf-opposed.[6]

In *Hexalobus*[7] (figs. 279, 280), the perianth is like that of a *Cyathocalyx*, or any of the species of *Artabotrys* analogous to *A. uncata*; but the six petals are united into a tubular corolla in the whole of the part enveloping the sexual organs. The membranous flat-

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came out. We may therefore accord priority to the specific name which he proposed.

[1] Hook. F., *Niger*, 207. — Benth., *Linn. Trans.*, xxiii. 466.—Miq., *Ann. Mus. Lugd. Bat.*, ii. 43.—Oliv. *Fl. of Trop. Afr.*, 27.

[2] Hook. F. & Thoms., *Fl. Ind.*, i. 127.—Thw., *Enum. Pl. Zeyl.*, 9.—Benth., *Fl. Hongkong.*, 10.

[3] Bl., *op. cit.*, 59, t. 28-31.—Miq., *Fl. Ind.-Bat.*, i. p. ii. 38; *Suppl.*, i. 154; *Ann. Mus. Lugd. Bat.*, ii. 38, 43.—Walp., *Rep.*, i. 80; *Ann.*, ii. 19; iv. 63; vii. 53.

[4] *C. zeylanicus* Champ., ex Hook. F. & Thoms., *Fl. Ind.*, i. 126.—B. H., *Gen.*, 24, n. 9.—Walp., *Ann.*, iv. 63.—H. Bn., *Adansonia*, viii. 312, 341.

[5] There are usually five or six in each row.

[6] The flower is on the whole quite that of a unicarpellary *Artabotrys*; and as we have said, there would be no doubt no reason for hesitating to suppress the genus *Cyathocalyx* if its flowers were borne on fasciate hooked axes, since unicarpellary species are admitted in the genera *Bocagea*, *Unona*, &c. As for the character derived from the depth of the calyx, which has given its name to the genus, it is of no great value, since it may vary as much in several genera otherwise perfectly natural, such as *Unona*, &c. Moreover, we should not forget that in certain species of *Artabotrys* the axis of the inflorescence is not, or at least is not constantly, hooked and flattened.

[7] A. DC., *Mém.*, 36, t. 5, A.—Endl., *Gen.*, n. 4718.—B. H., *Gen.*, 24, 956, n. 11.—H. Bn., *Adansonia*, viii. 312, 332, 341 (nec A. S. H. & Tul., *Ann. Sc. Nat.*, sér. 2, xvii. 133).

tened blades that surmount the sort of cap thus formed, are broad, tapering towards the apex, and corrugated in the bud,[1] where they only touch by their edges. The whole corolla falls off in a single piece. The calyx consists of three valvate leaves.[2] The stamens are indefinite, surmounted by a truncate prolongation of the connective.

Hexalobus grandiflorus.

Fig. 279.
Flower.

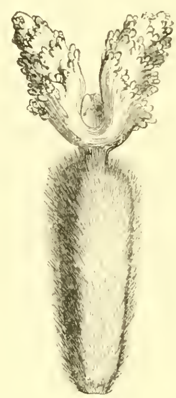

Fig. 280.
Carpel.

The number of carpels is also indefinite, but small.[3] Each ovary contains an indefinite number of ovules in two parallel rows,[4] and is surmounted by a style with two lateral papillate lobes, with the edges rolled up.[5] The fruit consists of a small number of many-seeded berries. Two or three species[6] of *Hexalobus* are known, natives of tropical Africa; trees or shrubs with alternate leaves and

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[1] They are especially covered with parallel horizontal plaits, so that in the young buds of *H. senegalensis* A. DC. (*Uvaria monopetala* Rich., Guill. & Perr., *Tent. Fl. Seneg.*, 8), the apex of the petal comes very near the base.

[2] The edge is often slightly reduplicate.

[3] There are often six; in this case each seems to be superposed to a corolla lobe.

[4] Bentham & Hooker state that they are sometimes in one row, sometimes in two (*Gen.* 950). But we have shown (*Adansonia*, viii. 332) that in the species that are undoubtedly of this genus there are always two vertical rows of ovules placed back to back.

[5] Each of these two lobes is a large triangular blade with its upper edge lobed and papillate, and it looks as if it had been twisted up into a cornet, like a sheet of paper. There is, moreover, as shown in fig. 280, a terminal median lobe, relatively very short and obtuse. The floral receptacle is nearly plane in *H. grandiflorus*, and depressed and surrounded by a projecting ring in *H. senegalensis* (see *Adansonia*, viii. 329).

[6] Rich., Guill. & Perr., *Tent. Fl. Senegamb.*, *loc. cit.*, t. 2.—Benth., *Trans. Linn. Soc.*, xxiii. 467, t. 49.—Walp., *Rep.*, i. 80.—Oliv. *Fl. of Trop. Afr.*, 26. We have described (*Adansonia*, viii. 348) a doubtful species of this genus. *H. brasiliensis* A. S. H. & Tul. belongs to *Trigynaia* (see p. 206); and perhaps, too, *H. madagascariensis* A. DC. (*Mém.*, 37, n. 2), should, we have said, be referred to the genus *Monodora* (*Adansonia*, viii. 301).

sessile or pedunculate solitary axillary flowers, below each of which are two lateral bracts with their edges in contact to form a sac, at first completely closed, surrounding the young flower-bud.

E. OXYMITREÆ.—The generic name *Oxymitra*[1] refers to an inner corolla in which the three pieces approach by their very thick upper parts, so as to form a sort of vault on three pillars above the sexual

Oxymitra (Goniothalamus) Gardneri.
FIG. 281.
Flower.

organs (fig. 281). The summit forms an erect, more or less acute cone; while the bases of the petals represent the pillars, and are more or less taper,[2] so that between them are three openings through which the stamens and gynæceum are seen. The outer petals correspond to these spaces, and are quite different to the inner ones, their edges being in contact with one another only in a very young bud; later on they spread more or less as blades of very variable size, thickness, and consistency. The calyx is much shorter still, and consists of three sepals, free or united at the base, also valvate in æstivation. The indefinite stamens are inserted in a spiral on a

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[1] BL., *Flor. Jav., Anonac.*, 71, t. 35, 36, D, 37. —ENDL., *Gen.*, n. 4713 b.—B. H., *Gen.*, 26, 957, n. 21.—H. BN., *Adansonia*, viii. 341.

[2] In *O. patens* BENTH. the petals are short, concave, and sessile; in several Asiatic species they form a vault more or less acute at its summit, and are separated from one another at the base by narrow elongated triangular spaces. In *Goniothalamus*, BENTHAM & HOOKER (*loc. cit.*) say of the inner petals "*basi in unguem latum angustata.*" Now this basilar claw is usually even broader still in the true *Oxymitras*.

more or less convex receptacle. They are of the same form as in *Unona* and *Uvaria*, the connective bearing a dilatation of very variable form[1] above the extrorse anther-cells. The carpels are indefinite, and each ovary contains one or two ovules inserted on the inner angle near its base or a little higher up.[2] The fruit consists of a variable number of stipitate one-seeded berries. The seeds differ greatly in form according to the species. Thus they are smooth and globular or ovoidal in most of the Indian and Javanese[3] species of *Oxymitra*, as well as in *Goniothalamus*[4] (fig. 281), which we cannot separate from this genus, for the only difference that can be pointed out in its flowers is that at the base the outer petals are a little thicker, and the inner ones are a little broader.[5] But in certain African species, as *O. patens*,[6] the seeds become spheres bristling with conical projections (figs. 282, 283), and some of the carpels contain

Oxymitra patens.

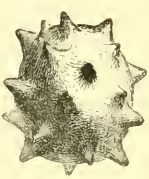

FIG. 282.
Seed.

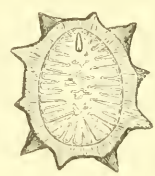

FIG. 283.
Longitudinal section of seed.

two seeds. In some other *Oxymitras* from Oceania, which have been made the type of a genus *Richella*[7] (figs. 284–286), the seeds are

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[1] It is sometimes depressed and capitate, sometimes ovoidal, or more or less elongated and conical; these characters vary with the species, all the other characters of the flower remaining the same.

[2] Never have they appeared to us exactly basilar—that is, erect. They are often incompletely anatropous. The micropyle looks downwards and outwards, but it is often at some distance from the umbilicus. The style of *O. patens* is short and depressed in the stigmatiferous part, while it is like a very long oblique cone in several Asiatic species. It is sometimes simple, sometimes bifid at the apex.

[3] BL., *loc. cit.*—HOOK. & THOMS., *Fl. Ind.*, i. 145.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 50; *Ann. Mus. Lugd. Bat.*, ii. 29.—ZOLL., *Linnæa*, xxix. 324.—THWAIT., *Enum. Pl. Zeyl.*, 29.—WALP. *Ann.*, iv. 72; vii. 56.

[4] BL., *Fl. Jav.*, *Anonac.*, 71, t. 39, 52, B.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 58; *Ann. Mus. Lugd. Bat.*, ii. 33.—WALP., *Ann.*, iv. 51; vii. 56.—THWAIT., *Enum. Pl. Zeyl.*, 33.—B. H., *Gen.*, 26, n. 22.

[5] These differences are, moreover, far from constant, and in *Goniothalamus* some flowers may have their inner petals simply sticking to one another, so that slight traction will separate them. The same thing may occur in *Oxymitra* proper.

[6] BENTH., *Linn. Trans.*, xxiii. 472, n. 4, t. li. —H. BN., *Adansonia*, v. 363.—OLIV. *Fl. Trop. Afr.*, 34. The ovules are described and figured in BENTHAM'S work as parallel, and separated by a vertical septum; in the flowers we have been able to dissect it has appeared to us horizontal. In the fruit one seed is above the other, and they are separated by a well marked horizontal septum.

[7] A. GRAY, *Amer. Explor. Exped.*, i. 28, t. 2, —B. H., *Gen.*, 26, n. 20.—H. BN., *Adansonia*, viii. 177.—SEEM., *Fl. Vitiens.*, 5.—WALP., *Ann.*, vii. 56.

sometimes triquetrous with the edges (especially the two lateral ones) prolonged into thin wings. However, these wings may be thickened and project but little as in a species from New Caledonia that we have hence named *O. obtusata*,[1] which thus affords a transition between the typical *Richellas* and the Javanese *Oxymitras*. Besides, in *Richella* there may be more than two ovules in each carpel, for we have seen specimens whose pyriform berries contained three or four seeds[2] when ripe (fig. 284).[3]

The smaller flowers of *Mitrephora*[4] are of the same general structure. But they are easily distinguished by a very striking

Oxymitra (Richella) Grayana.

FIG. 285.
Seed.

FIG. 284.
Four-seeded berry.

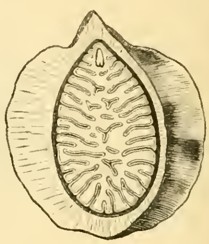

FIG. 286.
Longitudinal section of seed.

character, though one of little importance in itself: the tapering basilar part of the petals is very long; so that three very long and slender pillars support the vault that they form high above the

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[1] *Adansonia*, viii. 178.

[2] Hence we have been unable to retain the specific name of *monosperma*, for which we have had to substitute that of *Grayana*.

[3] We have not been able to observe, and only know by description, a genus which appears very nearly allied to *Oxymitra* and *Goniothalamus*, and that has been named *Atrutregia* (BEDDOME, *Madr. Journ. Litt. Sc.*, ser. 3, i. 37, fig. 1, ex B. H., *Gen.*, 957, n. 22 *a*). Its calyx consists of four (?) small sepals, and its corolla of six valvate coriaceous petals. The three outer are oval acuminate, and cohere around the sexual organs. The indefinite stamens are surmounted by an obtusely acuminate projection of the connective. The subglobular receptacle also supports an indefinite number of carpels with uniovulate ovaries (ovules erect) surmounted by an elongated style tapering into a two-branched terminal stigma. It is a small tree from Peninsular India, with the leaves glabrous, acuminate, and the flowers either solitary axillary, or springing from nodes which have lost their leaves. The whole surface of the outer petals and the outer faces of the inner ones are covered with hairs.

[4] BL., *Fl. Jav.*, *Anonac.*, 13, t. 10, 11, 12, 14, C, D. (sect. *Uvariæ*).—ENDL., *Gen.*, n. 4717 a (*Uvaria*).—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 30; *Ann. Mus. Lugd. Bat.*, ii. 27.—B. H., *Gen.*, 26, 957, n. 23.—H. BN., *Adansonia*, viii. 329, 342.—*Pseuduvaria* MIQ., *Fl. Ind.-Bat.*, i. p. ii. 32.—*Orophæa* MIQ., *Ann. Mus. Lugd. Bat.*, ii. 22, ex part. (nec BL.).

sexual organs (fig. 287). The outer petals seem to be so much the shorter in consequence, coming very near sepals in size, form, and consistency.[1] The stamens and carpels are arranged, as in *Oxymitra*, on a slightly convex receptacle; but each ovary contains an indefinite number of ovules in two vertical rows.[2] The stipitate berries each contain one or several seeds. The genus *Mitrephora* consists of trees and shrubs from tropical Asia and the neighbouring parts of the Indian Archipelago.[3] Their leaves are rather thick, with the

Orophæa corymbosa.

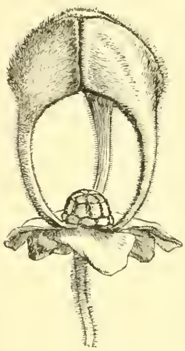

FIG. 287.
Flower ($\frac{5}{1}$).

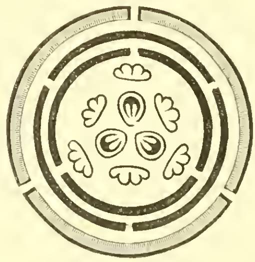

FIG. 288.
Diagram.

secondary veins often parallel and prominent. The flowers are axillary, terminal or lateral, solitary or in cymes, which may themselves be isolated or grouped into a cluster on a common axis. They are sometimes diclinous.[4]

The genus *Orophæa*[5] consists of natives of the same countries as

[1] Hence there are species that in the structure of the corolla come very near the *Phæantheæ*, as do several species of *Mitrephora*, and certain Asiatic *Popowias*. The outer petals are usually obtuse and spreading; the inner ones cohere by the edges of their broad limbs, and often the vault formed by their union falls on one side owing to the bending of the long slender claws. But often, too, their limbs finally separate from one another, and the interior corolla presents a true expansion.

[2] The floral receptacle is usually convex; it is however slightly hollowed out at the insertion of the carpels, which it surrounds by a small annular projection in certain Javanese species.

[3] HOOK. & THOMS., *Fl. Ind.*, i. 112.—HASSK., *Retzia*, i. 116.—THWAIT., *Enum. Pl. Zeyl.*, 8.—ZOLL., *Linnæa*, xxix. 315.—WALP., *Ann.*, iv. 55; vii. 57.

[4] This occurs in *Pseuduvaria* MIQ., rightly referred by BENTHAM & HOOKER to the genus *Mitrephora*, of which it has the stamens, but by MIQUEL finally included in *Orophæa* (*Ann. Mus. Lugd. Bat.*, ii. 22). But the stamens of *Pseuduvaria* are quite those of *Uvaria*, and the synonomy of the typical species must be thus re-established: *Mitrephora reticulata* B. H.—*Uvaria reticulata* BL. (*op. cit.*, t. 24).—*Pseuduvaria reticulata* MIQ.—*Orophæa reticulata* MIQ.

[5] BL., *Bijdr.*, 18.—ENDL., *Gen.*, n. 4711.—B. H., *Gen.*, 29, 958, n. 36.—H. BN., *Adansonia*, viii. 342.—*Bocagea* BL., *Fl. Jav.*, *Anonac.*, t. 40, 45 (nec *Auctt.*).

Mitrephora,[1] of which they have the flowers. The three petals forming the inner corolla are in fact more or less taper towards the base,[2] and are united edge to edge by their expanded limbs to form a sort of vault, three-pillared, above the reproductive organs. But these last differ in the following points; the number of stamens is smaller,[3] often definite, sometimes reduced to six[4] or nine;[5] the connective is not prolonged above the anther-cells into a thick fleshy body; if extending at all beyond them it only forms a narrow, slightly prominent blade; each of the carpels, whose number may be reduced to three, contains only a single ovule, or else from two to four. A dozen true species of *Orophæa* are known, shrubs with alternate leaves, often ill-developed. Their flowers are axillary and grouped into clusters of variable length, often bare at the base. The pedicels are articulated, and often fall early; the bracts to which they are axillary are often very close to each other, and imbricated.

The flowers of *Cymbopetalum*[6] are large, closely analogous to those of *Mitrephora*. In fact, in the plant that has served as the prototype to this genus,[7] we find that the inner petals have very broad limbs and narrow claws, and shelter the reproductive organs with the expanded part. But the large petals do not cohere together by their limbs, and are thick, coriaceous, and dilated like a sort of enormous spoon, with involute edges and an inflected mucronate apex. The outer petals are short and broad at the base, and even more than in *Mitrephora* approach the sepals in form and

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[1] BL., *loc. cit.*; *Fl. Jav.*, *Anonac.*, t. 40–44. —A. DC., *Mém.*, 38, t. 4.—HOOK. & THOMS., *Fl. Ind.*, i. 110.—ZOLL., *Linnæa*, xxix. 297. —THW., *Enum. Pl. Zeyl.*, 8.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 29; *Ann. Mus. Lugd. Bat.*, ii. 22. (Several of this author's species are *Mitrephoras*.) —BEDD., *Trans. Linn. Soc.*, xxv. 210, t. 21.— WALP., *Ann.* iv. 54; vii. 59.

[2] They usually taper abruptly in this basilar portion, which is much elongated. Without separating from one another they may all lean to one side and leave the reproductive organs uncovered. But in *O.? obliqua* HOOK. & THOMS. (*Fl. Ind.*, i. 112), the inner petals are shorter than the outer ones, and hardly taper towards the base. In *O. zeylanica*, HOOK. & THOMS. (*loc. cit.*), the summit of the inner corolla is much more elongated than in the other species, in which it often represents a nearly horizontal table.

[3] There are, however, species in which the number of stamens rises to fifteen or eighteen.

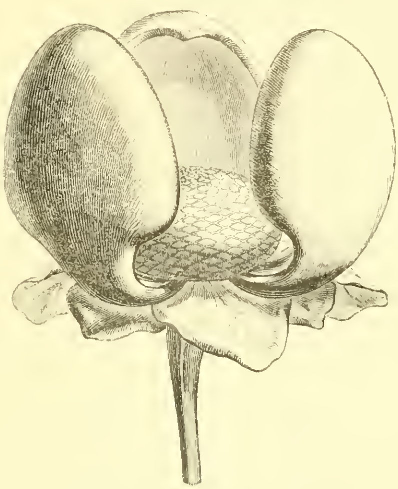
[4] The flowers of *O. corymbosa* (*Bocagea corymbosa* BL.) usually have this number (fig. 288). The three largest stamens are superposed to the sepals. In *O. obliqua*, the three large stamens are quite internal to the three small ones. In *O. coriacea* THW., the androceum also forms two very distinct trimerous verticils, as it does too in *O. zeylanica*.

[5] This number is observed in flowers of *O. polycarpa* A. DC. (*Mém.*, 39). The six outer stamens are in this case the shorter and seem arranged in pairs.

[6] BENTH., *Journ. Linn. Soc.*, v. 69.—B. H., *Gen.*, 27 n. 28.—H. BN., *Adansonia*, viii. 268, 298, 342.

[7] *C. brasiliense* BENTH., *loc. cit.*—*Uvaria brasiliensis* VELLOZ, *Fl. Flum.*, v. t. 122.— MART., *Fl. Bras.*, *Anonac.*, 39, t. 13, fig. 2.

colour. They are, moreover, valvate in the bud, like the sepals, which become more or less reflexed on the peduncle. The receptacle is dome-shaped, and bears a large number of stamens (of *Uvaria*), inserted in a very regular spiral. The indefinite carpels[1] consist of a pluriovulate ovary, with a short style dilated at the summit into a thick stigmatiferous head. The fruit is formed of a variable number of carpels, somewhat like little pods divided incompletely by oblique inflections of the pericarp into as many compartments as there are seeds. These are arillate, and in other



Cymbopetalum penduliflorum.[2]
FIG. 289.
Flower.

respects like those of most *Anonaceæ*. It is said that the carpels dehisce more or less completely when ripe.[3]

The characters presented by the petals, so well marked in this plant, become somewhat less decided in other species which we have referred to the same genus, such as *Unona obtusiflora* DC.[4] Here there is much less difference in size and form between the outer petals and the inner ones, the former being much larger and oval

[1] In some flowers they appear absent; these plants may then become polygamous like some species of *Mitrephora*.

[2] H. BN., *Adansonia*, viii. 268.—*Uvaria penduliflora* MOC. & SESS., *Fl. Mex.*, *ined.*, ex DUN., *Mon.*, 100, t. 28; DC., *Syst.*, i. 487; *Prodr.*, i. 89, n. 3.

[3] "*Baccæ stipitatæ oblongæ, sub pressione sæpe apertæ*" (B. H., *Gen.*, *loc. cit.*). We have in fact seen the fruits open towards the apex for a certain distance along the ventral angle; but it is possible that this rupture only occurs in the herbarium.

[4] *Syst. Veg.*, i. 487; *Prodr.*, i. 89, n. 7.

acute, while the claws of the latter are much shorter and narrower.[1] The petals only approach the form of those of *C. brasiliense* towards the time of the complete expansion of the flower, remaining until then very much like those of several true *Unonas.* But the sexual organs and fruit (fig. 290)[2] are exactly those of *Cymbopetalum.* We already know nine species of this genus,[3] small American trees found between Mexico and Brazil, with subsessile membranous leaves, often somewhat unsymmetrical at the base. The flowers are solitary and terminal, leaf-opposed or extra-axillary, usually on very long peduncles.[4]

Cymbopetalum obtusiflorum.
Fig. 290.
Fruit.

Beside *Cymbopetalum* has been placed *Enantia,*[5] in which there are only six leaves to the perianth: three sepals and three petals superposed to them. The former are lanceolate and valvate; the latter are much longer, erect or slightly spreading, thick and coriaceous, flat, or with slightly reflexed edges, and with a concave contracted base. The convex receptacle bears an indefinite number of linear-oblong stamens, whose dilated connective is but little dilated above the anther-cells. The carpels are also indefinite; each ovary contains a single erect ovule, and is surmounted by a short linear oblong style, traversed by an internal longitudinal groove. *E. chlorantha* Oliv., the only species known, is a tree from the west of tropical Africa, with alternate membranous leaves, and solitary extra-axillary flowers on short peduncles.

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[1] The calyx also becomes very different from the inner petals, especially in thickness. It is at first a membranous globular sac, completely surrounding the corolla in the bud.

[2] Here the fruit, though of quite the same appearance as in *C. brasiliense* appears thoroughly indehiscent. We see also from fig. 290 that the lowermost segment remains empty and of small size, but is separated from the rest of the carpel by a well-marked, nearly transverse furrow.

[3] To which we have referred (*Adansonia,* viii. 298) *Unona penduliflora* Dun. (fig. 289), *viridiflora* Splitg., *obtusiflora* DC., and with some doubt, *U. fuscata* DC. Sect. *Brachycymbium.*

[4] They may be either erect, or pendulous, as in *C. penduliflorum,* and are sometimes even thicker than the branch from which they spring.

[5] Oliver, *Journ. Linn. Soc.,* ix. 174.—B. H., *Gen.,* 958, n. 28*a*.—H. Bn., *Adansonia,* viii. 343.

II. MILIUSA SERIES.

The flowers of *Miliusa*[1] (figs. 291–294) are regular, hermaphrodite or polygamous. On the receptacle are inserted in order a triple perianth, and the indefinite pieces of the androceum and gynæceum. The calyx consists of three narrow sepals, valvate in æstivation. The

Miliusa indica.

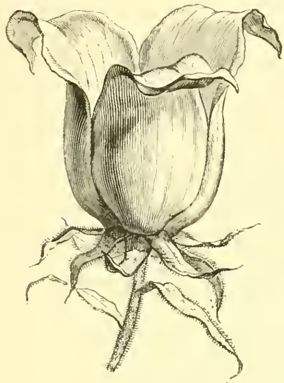

Fig. 291.
Flower.

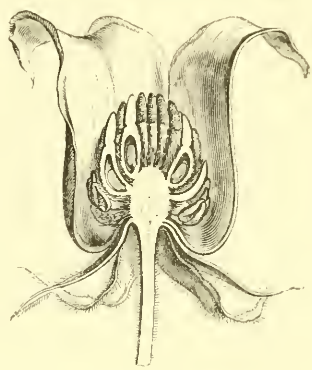

Fig. 292.
Longitudinal section of flower.

Fig. 293.
Flower, corolla removed.

Fig. 294.
Diagram.

petals of the inner whorl, superposed to the sepals, are broad and

[1] Leschen., ex A. DC., *Mém.* 37, t. 3.—Wight & Arn., *Prodr.* i. 10.—Endl., *Gen.*, n. 4712.—B. H., *Gen.*, 28, 958, n. 34.—H. Bn., *Adansonia*, viii. 343.—*Hyalostemma* Wall., *Cat.*, n. 6434.—Lindl., *Introd. to Bot.*, ed. 439.—Endl., *Gen.*, n. 4729.—*Uvariæ* spec. Roxb., *Fl. Ind.*, ii. 664.

membranous, free, or cohering slightly below, and together have exactly the appearance of an ordinary corolla (figs. 291, 292); while the outer petals, of the same size, form, and consistency as the sepals, seem to form a second calyx, whose pieces alternate with those of the first. True, analogy tells us that the three tongues which form the second whorl of the perianth answer exactly to the outer corolla of other *Anonaceæ*. But at the same time all the external characters of these leaves again show us how it is often impossible, not to say useless, to fix any absolute distinction between sepals and petals.[1] But though this character possesses but little value in itself, it allows us to distinguish the *Miliuseæ* easily from other *Anonaceæ*; we may in practice say of them that, instead of a single calyx and two corollas, they have a double calyx and a single corolla. The indefinite stamens, inserted in a spiral on the convex receptacle, and shorter as they are lower down on it, have been long known to us by the conformation of the anther;[2] for this genus has, as we have seen, given its name to the stamens called *stamina Miliusearum*. The filament, short and narrow, is surmounted by two extrorse cells dehiscing longitudinally, and above them by a slightly conical projection of the connective (fig. 293). The carpels, also inserted in a spiral, consist each of a unilocular ovary surmounted by a conical papillose style, and containing either one or two ascending ovules, whose micropyles look outwards and downwards, or more rarely an indefinite number in two vertical rows. The multiple fruit consists of a variable number of umbellate, stipitate, one-seeded, or, more rarely, many-seeded berries. Within the seed coats is contained a fleshy ruminated albumen, with a small embryo close to its apex. The genus *Miliusa* consists of small trees or shrubs, with alternate leaves and solitary or cymose, axillary or extra-axillary flowers, borne on peduncles of variable length. In some species there are whole branches bearing none but male flowers. We know half a score species from India,[3] Malaysia,[4] and even Madagascar.

In *Miliusa* proper the bases of the broadest petals are flat, as in

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1 See *Adansonia*, viii. 309.

2 See pp. 200, 209.

3 A. DC., *loc. cit.*—ROXB., *Fl. Ind.*, ii. 664 (*Uvaria*).—HOOK. & THOMS., *Fl. Ind.*, i. 147.—THW., *Enum. Pl. Zeyl.*, 10.—WALP., *Ann.* iv. 74.

4 MIQ., *Fl. Ind.-Bat.*, i. p. ii. 51; *Ann. Mus. Lugd. Bat.*, ii. 40.—WALP., *Ann.*, iv. 59; zii. 59.

most *Anonaceæ*. However, in certain species, especially the one which served to found the genus, at the lower part of each of the inner petals is a sort of sac or obtuse spur projecting below the insertion of the petal (fig. 292). The designation *Saccopetalum*[1] has been applied to plants in which this gibbosity is more marked, so as to form a sort of purse or boat-shaped hollow. But as there is every transition between those species of *Saccopetalum* in which this is well developed, and those of *Miliusa* in which it hardly exists, it has appeared impossible to us to retain the two genera as absolutely distinct. Moreover, all other characters are the same in both, and *Saccopetalum* has the gynæceum of the multiovulate *Miliusas*. In the former the leaves are caducous, and the flowers spring from the axils of the last year's leaves; they are solitary, or in small clusters, often supported on long slender peduncles. The young leaves of their year appear with them, and are covered with rather copious down. These characters allow us to make of the six or seven known Oceanian and Asiatic[2] species a special section in the genus *Miliusa* as we understand it.

The flower of *Phæanthus*[3] is, as regards its perianth, exactly that of *Miliusa*, but the form of its stamens is different; they are formed like those of *Unona* and *Uvaria*, with a short dilatation of the connective, more or less depressed or rounded at the summit.[4] The ovaries and fruit are those of the uni- or biovulate *Miliusas*; but the ovules of *Phæanthus*, instead of being near the base of the ovary, are inserted a little higher up on the inner angle, and are slightly ascending, with the micropyle downwards and outwards. Only five species of *Phæanthus* proper are known, natives of India and the Indian Archipelago.[5] To this genus we think we may add *Heteropetalum brasiliense* BENTH.[6] (fig. 295) as the type of a separate section

[1] BENN., *Pl. Jav. Rarior.*, 165, t. 35.—ENDL., *Gen.*, *Suppl.* i. n. 4712[1].—B. H., *Gen.* 28, 958, n. 35.—H. BN., *Adansonia*, vii. 343.

[2] WALP., *Rep.*, i. 74; *Ann.*, iv. 76; vii. 59.—HOOK. & THOMS., *Fl. Ind.*, i. 151.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 52.—ZOLL., *Linnæa*, xxxi. 325.—BENTH., *Fl. Austral.*, i. 53.

[3] HOOK. & THOMS., *Fl. Ind.*, i. 146.—B. H., *Gen.*, 27, 957, n. 25.—H. BN., *Adansonia*, viii. 343.

[4] This summit is like a long lozenge, with a large transverse axis in *P. nutans* HOOK. & THOMS., and its superior surface more or less concave. The anther-cells are either markedly extrorse, or nearly marginal. The filament is articulated at the base, and falls very early.

[5] WALP., *Ann.*, iv. 73; vii. 57.—ZOLL., *Linnæa*, xxix. 324.—MIQ., *Fl. Ind.-Bat.*, i. p. ii. 51; *Ann. Mus. Lugd. Bat.*, ii. 10.

[6] *Journ. Linn. Soc.*, v. 69.—B. H., *Gen.*, 27, n. 27.—H. BN., *Adansonia*, viii. 343.—*Guatteria heteropetala* BENTH., *Hook. Journ.*, ii. 360. If this species is referred to the genus *Phæanthus* it must take the name of *P. heteropetalus*. The large petals are not so thick as in the Asiatic species, and the thick connective is horizontally truncated above the anther-cells. The

belonging to South America. In this the flower and fruit are exactly those of the Indian species, except that the six small outer leaves of the perianth, all similar to one another, are a little broader at the base, and that the single ovule in each ovary is inserted quite at the base of the internal angle.

As another section of this genus *Phæanthus*, we also class those African plants which have been termed *Piptostigma*,[1] for their flowers possess a convex receptacle,[2] three large inner sepals veined like those of the Asiatic species of *Phæanthus*, and three outer petals that are much shorter, acute, and quite analogous to sepals, like those of *Heteropetalum brasiliense*. The stamens, indefinite in number, have wedge-shaped anthers surmounted by a truncate prolongation of the connective. The carpels, few in number, have styles that, as in *Heteropetalum*, swell into thick irregular stigmatiferous heads which all stick together. The only difference of any value that we can state here is that the ovules are numerous, and arranged in two vertical rows.[3] In this respect *Piptostigma* is to the American and Asiatic species of *Phæanthus* exactly what the pluriovulate species of *Miliusa* are to the uni- or biovulate species of the same group, and can no more be considered a distinct genus.[4] The two known species of this section have been observed in the western regions of tropical Africa.

Phæanthus heteropetalus.
FIG. 295.
Flower-bud.

Thus constituted,[5] the genus *Phæanthus* contains half a dozen trees with alternate leaves, and flowers either lateral, or axillary to leaves or bracts, solitary, or grouped into small cymes.

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styles are terminated by thick dilatations, which all stick together to form a common head, as in *Piptostigma*. The only species yet known has been observed in Brazil and Guiana.

[1] OLIV., *Journ. Linn. Soc.*, viii. 158, t. 2; *Fl. Trop. Afr.*, 18.—B. H., *Gen.*, 957, n. 25 *a*.—H. BN., *Adansonia*, viii. 313.

[2] In *P. glabrescens* OLIV., the part of the receptacle that bears the carpels is slightly concave.

[3] This arrangement is constant in the two known species. There are from three to five in each row.

[4] It is said (OLIV., *Fl. Trop. Afr.*, 19) that in the fruit of *P. pilosum* OLIV., the carpels cohere into a single mass containing the seeds surrounded by scanty pulp.

[5] *Phæanthus* Sections 3.
1. *Euphæanthus*. Ovules 1, 2 ventral.
2. *Heteropetalum*. Ovule 1, subbasilar.
3. *Piptostigma*. Ovules ∞, ventral.

III. MONODORA SERIES.

GÆRTNER gave the name *Anona Myristica*[1] to a plant which DUNAL

Monodora Myristica.

FIG. 296.
Floriferous branch ($\frac{2}{3}$).

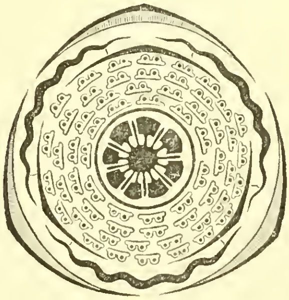

FIG. 297.
Diagram.

later made the type of his genus *Monodora*.[2] This plant (figs.

[1] *Fruct.*, ii. 194, t. 125, fig. 1.—LUN., *Hort. Jam.*, 10.

[2] *Mon.*, 79.—DC., *Syst.*, i. 477; *Prodr.*, i. 87.—R. BROWN, *Congo*, 56; *Misc. Works*, ed. BENN., i. 162.—ENDL., *Gen.*, n. 4725.—BENTH., *Journ. Linn. Soc.*, v. 72; *Linn. Trans.*, xxiii. 473, t. 52, 53.—B. H., *Gen.*, 26, 957, n. 24.—H. BN., *Adansonia*, viii. 299, 314.—OLIV., *Fl. Trop. Afr.*, 37.

296–299) has regular hermaphrodite flowers, and the receptacle is like a small sphere at the top of the peduncle. The calyx consists

Monodora Myristica.

Fig. 298.
Longitudinal section of flower.

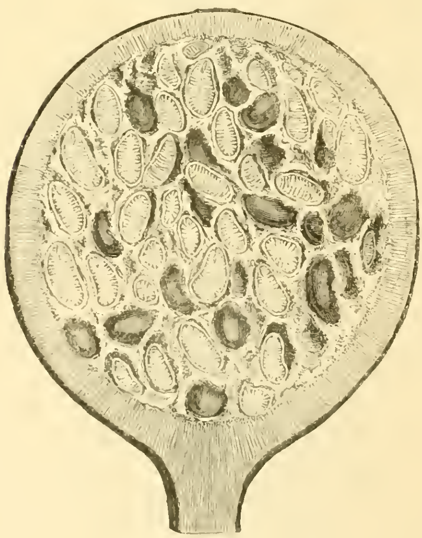

Fig. 299.
Longitudinal section of fruit ($\frac{1}{3}$).

of three sepals valvate in the bud. The corolla is gamopetalous, its six petals being united near the base into a short broad tube,[1] and

[1] This tube, usually passed over in descriptions unnoticed, is first reflexed on the peduncle, and then the petals rise in the opposite direction.

then free, valvate in æstivation. The three outer ones, long and narrow, alternating with the sepals, and, like them, with undulate edges, are reflexed in the completely expanded flower, while the three inner ones, far shorter and contracted at the base, approach one another above by their broadened, almost sagittate limbs. The stamens, inserted in a spiral on the sides of the spherical dilatation of the receptacle, are indefinite, free, each composed of a nearly sessile anther, with two linear adnate extrorse cells dehiscing longitudinally and surmounted by a truncate dilatation of the top of the connective. The ovary, which occupies the summit of the receptacle, is surmounted by a style that dilates rapidly, like that of a Poppy, into a large circular stigmatiferous plate with lacerated edges. The ovary contains only one cell, with numerous parietal placentas, bearing indefinite horizontal or ascending anatropous ovules on rather long funicles.[1] The fruit is an enormous berry, which finally becomes spherical and woody. It contains an indefinite number of seeds embedded in the thick pulp. The seed-coats, ruminated albumen, and small embryo here present the same characters as in most other *Anonaceæ*.

M. Myristica is a tree from tropical Africa, transported to the Antilles by negroes.[2] Its leaves are alternate, exstipulate; and the long peduncles of the large flowers spring from the side of the young branches of the season, opposite, or nearly opposite, the leaves. In an allied species, *M. tenuifolia*,[3] the flower also springs from a branch of its year, but it stands alone, far below the first of the leaves on this young branch. Later on the peduncle elongates and grows thick, and "it is the young branch which, pushed aside and small in proportion, appears to spring from the side of the peduncle." In this species the sepals cohere at the base, and the outer petals are ovate-lanceolate. The corolla has a similar form in a Zanzibar species which we have described[4] under the name of *M. Grandidieri*. Its outer petals are undulate, and the inner ones are much shorter, with a nearly sagittate limb and a contracted base. But this species is not glabrous like those from Western Africa. The differences of

[1] These ovules at first appear placed back to back in two parallel rows on each placenta.

[2] It is known that ROBERT BROWN was the first to give this opinion, which long appeared very improbable, but is now justified by the observations of travellers who have met with the plant native in the forests of Guinea.

[3] BENTH., *Journ. Linn. Soc.*, *loc. cit.*—H. BN., *op. cit.*, 300.

[4] *Adansonia, loc. cit.*, 301, note 1.

size and form between the inner and outer petals begin to grow less in *M. brevipes*.[1] Here the inner petals are not so narrow as the outer ones, but attain to about two-thirds of their length. In these two latter species also, the branch accompanying the flower is much less developed at the season of its expansion.

Thus we gradually arrive at a stage which puts it out of our power to make another genus for the curious species that we have named *M. madagascariensis*,[2] whose small flowers have a campanulate corolla, with six nearly equal lobes, which even appear arranged in a single whorl when adult. The calyx is here short and gamosepalous, and the corolla, instead of being reflexed from its base, is erect like a bell, with thick walls, and ends in six acute vertical teeth. Its valvate præfloration is very well marked. As to the androceum and ovary, they are exactly those of the other species of this genus. The style is much broader than the ovary itself, forming a large, fleshy, papillose, depressed head, surrounded at the base by a sort of annular cup. This species is frutescent and climbing. The leaves are alternate and simple. The flower is borne on an erect slender peduncle, accompanied by a young branch or leaf-bud, and is axillary to the leaf.

Only six species of *Monodora* are known, of which one-half belong to the west of tropical Africa.[3] The others grow on the east coast, or in Madagascar.[4] We may define these plants as *Anonaceæ*, with the gynæceum of a Poppy—*i. e.*, with the ovary and fruit unilocular and of parietal placentation.

IV. EUPOMATIA SERIES.

In *Eupomatia*[5] the flower is regular, hermaphrodite, without a perianth. The receptacle is concave like a funnel, whose edges give

[1] Benth., *Linn. Trans.*, *loc. cit.*, n. 4.

[2] *Op. cit.*, 299, note 1.

[3] Pal.-Beauv., *Fl. Owar.*, i. 27, t. xvi. (excl. fruct.) — Benth., *loc. cit.* — Welw., *Journ. Linn. Soc.*, iii. 151.—*Bot. Mag.*, t. 3059.—Walp., *Ann.*, vii. 57.

[4] H. Bn., *op. cit.*, 299, 301. R. Brown has referred to the genus *Cargillia* a supposed Australian species of *Monodora*, *M. microcarpa* DC. (*Syst.*, i. 478), or *Anona microcarpa* Jacq. (*Fragm.*, 40, t. 44, l. 7).

[5] R. Br., *App. Voy. Flind.*, ii. 597, t. 2; *Misc. Works*, ed. Benn., i. 73.—Juss., *Mém. Mus.*, v. 236.—Endl., *Gen.*, n. 4730. — F. Muell., *Fragm. Phyt. Austr.*, i. 45.—B. H., *Gen.*, 29, n. 40.—Benth., *Fl. Austr.*, i. 53.—Schnizl., *Icon.*, t. 174.—H. Bn., *Adansonia*, viii. 344, ix. 17; *Comptes Rendus de l'Acad. des Sciences*, lxvii. 250.

insertion to a large number of fertile and sterile stamens inserted in a spiral, and whose concavity bears the carpels, also arranged in a

Eupomatia Bennettii.

FIG. 300.
Floriferous branch.

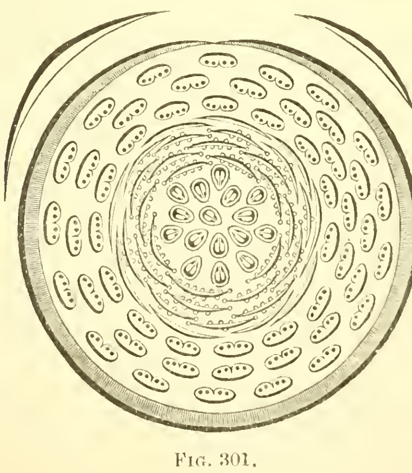

FIG. 301.
Diagram.

spiral over its whole surface. If we examine the flower on

anthesis, that is at the moment of the detachment of a sort of conical roof or cap which covered it in the bud (fig. 300), we shall see the male organs, of very variable form, rising up and spreading to throw off this operculum, under which they had been bent up and very closely imbricated. Following up their spiral from without inwards, we find successively as follows:—the fertile stamens, consisting of a filament that becomes more dilated and petaloid as we go further inwards, and an anther with two contiguous cells of longitudinal dehiscence, placed on the inner face of a ribbon-like connective, is prolonged into an apiculus above them; sterile stamens, or membranous petaloid blades, with the surface quite glabrous, gradually increasing in size; and finally, other staminodes like thicker, fleshier scales, dotted over with projecting capitate glands, much imbricated, and growing smaller as we approach the gynæceum. These glands first appear on the inner face, on which they are always more numerous than on the outer face and the crenulate edges. The whole concavity of the receptacle is filled by the wedge-shaped ovaries,[1] which are crowded together below, and free above, where they terminate internally by a short stylar horn, stigmatiferous at the tip.[2] In the inner angle of each is a placenta bearing a variable number of ascending anatropous ovules in two parallel rows, their raphes a little towards one another.[3] The fruit is multiple, consisting of a large number of many-seeded carpels crowded together within the top-shaped cavity of the receptacle, now grown fleshy, whose rim enframes the styles and projects a little above them; the traces of these last are still found on a sort of circular nearly horizontal platform, formed by the upper surfaces of the individual fruits. The seed contains ruminate albumen and a small embryo near its apex. As yet only two species of this genus are known, Australian shrubs with alternate exstipulate leaves.[4]

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[1] They, too, are arranged in a spiral whose turns are close together. A little more than half way up the back of each is an angular projection, a little hump which fits exactly into the interval between two of the carpels outside of it. The carpels thus moulded on one another do not, however, cohere, but are only compressed and crowded together.

[2] This tip is a sort of little papillose button, that has nothing in common with what most authors have described as the stigma, for they say that "the styles are welded together into a mass, terminated by a flat stigma pitted by as many areolæ as there are carpels." Now there is no welding of the styles; the free stigmas are equal in number to the carpels, and the areolæ in question certainly represent those portions of the backs of the ovaries that are above the external projections of which we have spoken.

[3] Later on the ovules are displaced, so that one of them is as it were enframed in a ring by the others. In *E. Bennettii*, there are from three to six ovules in each row. They have two coats, and the top of the secundine is flask-shaped, and projects through the exostome.

[4] Benth., *Fl. Austral.*, i. 53.

E. laurina[1] (figs. 302–305), the taller of the two, has a thicker woodier trunk and axillary flowers. The other, *E. Bennettii*[2] (figs. 300, 301), developes like a perennial herb; it has a running stock from which arise almost herbaceous aerial branches, each ending in a pedunculate more or less drooping flower. Beneath this are several

Eupomatia laurina.

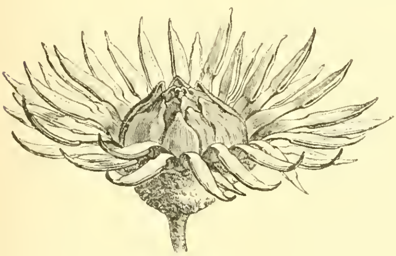

FIG. 302.
Expanded flower.

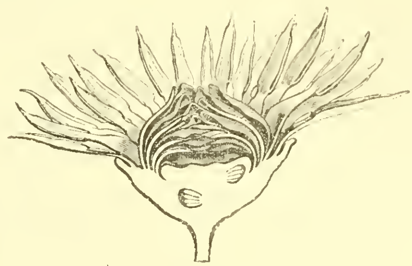

FIG. 303.
Longitudinal section of flower.

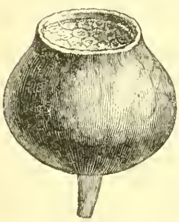

FIG. 304.
Fruit.

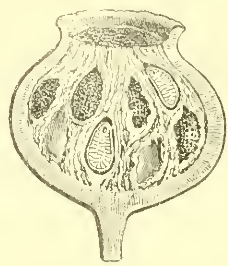

FIG. 305.
Longitudinal section of fruit.

bracts, which gradually become smaller as they are higher up, and the arrangement of which is continuous with that of the leaves. The last one is inserted on the very edge of the receptacular cup, and is reduced to a sheath which covers in the sexual organs in the bud like a hood, and on the expansion of the flower falls off by its circular

[1] R. BR., *loc. cit.*—F. MUELL., *loc. cit.*, n. 1 (nec HOOK.). In a single axil there are two (more rarely three) flowers placed one above the other, or as many leaf-buds with superposed leaves. The peduncle of each flower bears one or several alternate bracts below the one that is so much developed to surround the whole flower. *E. laurina* is a rather large shrub with urceolate fruits, and connivent petaloid staminodes shorter than the fertile stamens.

[2] F. MUELL., *loc. cit.*, n. 2.—*E. laurina* HOOK., *Bot. Mag.*, t. 4848 (nec R. BR.). In this the staminodes are richly provided with glands, and longer and broader than in the preceding species, and on anthesis spread more or less over and beyond the fertile stamens. The fruit is turbinate. The roots with which the stock is provided swell here and there into reservoirs of nutritive juices owing to the development of their cortical parenchyma.

base so as to free the fertile and sterile stamens that push it off.[1] We may, then, define the genus *Eupomatia* as *Anonaceæ* with naked flowers, in which the perianth is replaced by a single modified leaf, and the carpels are inserted on a concave receptacle. It is in this order analogous to *Trochodendron* amongst the *Magnoliaceæ*.

Anonæ form Family XLVI. of ADANSON's great work; this, as we have seen, includes not only those *Anonaceæ* that were then known, but also *Magnoliaceæ*, *Menispermaceæ*, several *Dilleniaceæ* and *Ranunculaceæ*, *Ochna*, and *Fagara*. Of this group the genera which really belong to *Anonaceæ* are four in number—viz., *Anona*, *Xylopia* (*Xylopicron*), *Uvaria* (*Narum*), and *Asimina*. ADANSON was the first to recognise the analogies between *Xylopia* and *Anona*; and his genus *Narum* includes both *Uvaria* proper and also the Asiatic *Unonas* of the group *Cananga*. The *Anonæ* of A. L. DE JUSSIEU only include the five genera *Anona*, *Unona*, *Uvaria*, *Cananga*, and *Xylopia*. Most of the other genera united to these by ADANSON, he reserved for his order *Magnoliaceæ*. L. C. RICHARD gave the collection the name of *Anonaceæ*, and this order was only really established in the work published by DUNAL in 1817, so wonderful considering its date. To the genera above enumerated are there added the following:—*Kadsura*, which belongs to *Schizandreæ*; *Monodora*, whose type is the *Anona Myristica* of GÆRTNER; *Porcelia*, which RUIZ & PAVON had made known in 1794, and *Guatteria* of the same authors, corresponding to AUBLET's *Cananga*. *Desmos* and *Melodorum*, proposed as distinct genera by LOUREIRO in 1790, are by us incorporated with the great genus *Unona*. A. P. DE CANDOLLE, in 1824, fully adopted the arrangement of *Anonaceæ* proposed by DUNAL. Soon after, BLUME completely revised most of the Old World genera, assigned more exact limits to the existing genera *Unona* and *Uvaria*, and established, either as distinct generic types or as sections of other larger genera, the groups *Oxymitra*, *Mitrephora*, and *Orophæa*, whose autonomy we maintain. About the same period, A. DE SAINT-HILAIRE was doing the same work for the American *Anonaceæ*, and successively created the genera *Anaxagorea*, *Duguetia* (*Aberemoa* of AUBLET, 1775),

[1] The flowers only last a day, after which the whole set of stamens, sterile and fertile, come off in a single circular piece, their bases being united into a sort of ring inserted near the edge of the receptacular cup.

Rollinia, and *Bocagea*. R. Brown had in 1820 established the genus *Artabotrys*, for those Old World species of *Uvaria* and *Unona* in which the principal axis of the inflorescence is like a flattened fasciated hook; and the genus which he had made known six years earlier, under the name of *Eupomatia*, though long held of doubtful affinities, and unfortunately pointed out by A. L. de Jussieu, as the type of a new order near *Osyrideæ*, was already accepted by several botanists as nearly allied to the *Anonaceæ*. In 1832, A. de Candolle was led, in a special work on this order, to break up the genus *Xylopia*, which is now reconstituted, and to propose two new generic types—*Miliusa* of Leschenault and the monopetalous genus *Hexalobus*. So there existed at that time sixteen of the genera retained by us in the order *Anonaceæ*. The twelve others are of quite recent creation. Between 1832 and 1866, English botanists made known the genera *Sageræa*, *Cyathocalyx*, *Phæanthus*, *Sphærothalamus*, *Disepalum*, *Cymbopetalum*, *Cleistochlamys*, *Enantia*, *Atrutregia*. Endlicher had named *Popowia* in 1838; A. Richard, *Oxandra* in 1850. Miquel is the latest author who has studied the *Anonaceæ* of tropical Asia *in situ*; he established the genus *Tetrapetalum* in 1866, thus raising the number of genera received by us to twenty-eight. But of these it is probable that some will be suppressed when transition terms shall be better known, that will allow us to admit them as sections into several of the older genera. We have fortunately not been compelled to establish any fresh generic type in this order.

On seeking out the characters constant in all these groups we find that there is no Anonad that is thoroughly herbaceous; that all have alternate exstipulate leaves, and in the seed contain fleshy ruminated albumen.

Other important characters are so common in this order that their absence has only been made out in one single genus thus distinguished from the rest. These are as follows:—

I. The form of the floral receptacle and the resulting insertion of the androceum.—Only in one type, *Eupomatia*, has the flower a totally concave receptacle, with its stamens all inserted above the gynæceum.

II. The presence of petals and sepals.—In *Eupomatia* alone are the sexual organs surrounded by a simple bract, which falls off by its base, and plays the protecting part of a perianth, this being really absent.

III. The independence of the carpels.—In *Monodora* alone are

they united edge to edge to form a one-celled ovary with parietal placentas. All other *Anonaceæ* are what have been termed *polycarpiceæ*.

IV. The aspect of the anthers.—These are introrse in *Eupomatia* only, lateral or extrorse in all the other genera.

In the third rank come characters that are undoubtedly of less importance than the preceding, as different ones are absent in several genera more or less closely allied. They can only serve to distinguish these genera, or at most to separate them into sub-series, such as we have had to establish in the immense series *Anoneæ*. We will especially call attention to the following:—

The type of the verticils of the perianth.—These are almost always trimerous. But the binary type is found in and characterizes *Tetrapetalum* among the *Uvarieæ*, and *Disepalum* among the *Unoneæ*.

The presence of dorsal appendages on the petals.—These only exist in the secondary group, *Rollineæ*, and their form may serve to distinguish its four genera.

The absence of the outer corolla has only been ascertained in the genus *Enantia*.

The consistency and dehiscence of the pericarp.—In *Anaxagorea* alone does the fruit consist of true follicles. This one point characterizes the genus. The fruits of *Xylopia* and *Cymbopetalum*, if they open at all, do not open in so marked and complete a way. In all other *Anonaceæ* the pericarp is indehiscent, and the fruit consists of more or less fleshy berries.

There are, finally, characters which, though we cannot refuse them a great value in particular cases, must be relegated to the last place; for, as shown above, they never possess that absolute significance which was often accorded to them at a time when the *Anonaceæ* studied were relatively few in number. On enumerating these characters in succession, we shall see under what exceptional circumstances they may acquire sufficient importance to become the stamp of a genus, or even a sub-tribe of the order.[1]

1. The præfloration.—It has no value as regards the calyx, for in one single genus we may find the sepals imbricate, valvate, and

[1] Most of these have been already discussed by us in the special memoir on the *Anonaceæ* we published in *Adansonia* (viii. 162, 295), to which we must refer the reader for a development of the subject unsuited to the present work.

even with their edges not at all in contact. In the corolla the æstivation has served to distinguish considerable groups, such, for example, as the *Unoneæ* and *Uvarieæ*. But on this point we must insist less than most authors; for in the genus *Uvaria* some species have both corollas imbricated, others the one imbricated the other valvate; *Anona*, whose petals are usually valvate, may have them most markedly imbricated,[1] as is the case too in certain *Unonas* of the group *Polyalthia*.[2]

2. The conformation of the pieces of the perianth, their form and relative size.—This character is another which has been placed in the first rank, having been used by BENTHAM & HOOKER to establish all their tribes except one; and these botanists have, as we have seen, distinguished the three corollas which they term of the *Unoneæ*, *Xylopieæ*, and *Mitrophoreæ*. That these forms are well marked towards the culminating points of these groups is incontestible, and hence we have avoided neglecting such a character in the subdivision of the great group *Anoneæ* into minor sections. But we have not founded true series on it, because there is one common type of structure towards which all these forms gradually converge, so that we get stages in which we cannot surely distinguish the Unonean type of corolla from the Mitrophorean or Xylopiean. Of this we have cited numberless proofs; here it will be sufficient to recall the fact that in the *Melodorum* group alone (including *Pyramidanthe*) there are at the same time corollas of *Unona* and *Xylopia*, and that we find the same thing in *Anona*, *Bocagea*, &c.; while the conformation of the perianth of *Popowia* has caused it to be classed by some among the *Unoneæ*,[3] by others among *Mitrephoreæ*.[4] Thus, again, it is because structural characters derived from the relations of form and size stated to occur in the different pieces of the perianth are by no means absolute, that we have proposed as of practical utility and convenience, though in no

[1] See especially what we have said relative to the corolla of *A. muricata* (p. 222).

[2] We know, and shall at some future time describe several Old World plants that can hardly be referred elsewhere than to *Polyalthia*, though their petals are distinctly imbricated. It may be easily divined how they are also closely allied to the genus *Cananga* (*Guatteria*). Perhaps, then, the future will compel us to recast certain genera, and will no doubt lead to a fresh reduction in their total number.

[3] B. H., *Gen.*, 25, n. 19. It is true that the authors add to their description: "*Genus vix rite limitatum.*"

[4] HOOK. F. & THOMS., *Fl. Ind.*, i. 105. Certainly the corolla of the Asiatic species is in most cases rather that of the *Phæantheæ* than that of the *Mitrephoreæ* proper or the *Unoneæ*; but they cannot be separated from the African species.

way essentially natural, the establishment of a group *Miliuseæ*, where the outer petals are, as we have seen, far more similar to sepals than to the pieces of the inner corolla. We knew in fact that there were genera foreign to this group, such as *Popowia*, *Mitrephora*, and *Orophæa*, in certain species of which the outer petals were already becoming in form and size less like the inner petals, and so were tending to approach the calycine leaves.

3. The absence of the inner petals is of itself insufficient to characterize a genus, for there are genera, recognised as perfectly natural, where the outer petals gradually become much smaller than the inner ones, and before finally disappearing are even reduced to very small spoon-like bodies. We may cite certain species of *Anona*, *Rollinia*, and one abnormal *Rollinia* of the section *Clathrospermum*. Most species of *Unona* have a well-developed corolla; but in some it is quite absent.

4. The independence or union of the pieces of the perianth has never appeared to us sufficient to characterize a genus. *Hexalobus* for instance is not merely *Unona* with a gamopetalous corolla; other features mark it out, and we have sketched them.[1] But it is impossible to make a generic distinction between those species of *Uvaria*, *Unona*, and *Rollinia*, in which the corolla comes off in a single piece, and those other species of these genera whose structure is otherwise quite the same.[2] The corollas of the *Monodoras*, varying greatly in form, are all gamopetalous; but this feature alone would not be thought worthy to put them in a group apart, if the peculiar organization of their gynæceum did not give them so marked a distinction.[3] Nor is the union or freedom of the calyx-leaves a character of more value; for it may happen that of two species of the same genus, as closely allied as possible, the one may have free sepals, the other an urceolate calyx, with three teeth hardly projecting on the edge.

5. The number and arrangement of the stamens.—We have

[1] See p. 226. It might not, however, be impossible to meet with some species which should connect this genus with one of the sections of *Artabotrys*. For the present the union of the petals is at once sufficient to distinguish the genera.

[2] It is no doubt for the same reason that *Hexalobus brasiliensis* A. S. H. & Tul. has been included in *Trigyneia* by Bentham & Hooker, though its corolla is decidedly gamopetalous.

[3] We should further notice the consequence of gamopetaly in this genus; it is that the three divisions of the corolla superposed to the sepals may finally appear to stand on the same verticil as the three outer ones. Probably this is not the case when they are young.

shown that this character is at most only sufficient to justify subdivisions within a genus. The stamens are almost always indefinite in the *Anonaceæ*, and it is only since the time of A. DE SAINT-HILAIRE that it has been known that *Bocagea* may have an androceum of subdefinite elements. The study of *B. heterantha* has proved to us that the number of stamens may be even quite definite, limited to three or six; as is also the case with some species of *Orophæa*. But at the same time we have had to unite the American *Bocageas* and the Asiatic *Alphonseas* into a single genus. Now the latter often have indefinite stamens. Moreover, when the stamens of the *Anonaceæ* are very numerous, they appear, when adult, arranged in a spiral, while in the species of three, six, or nine stamens the existence of trimerous or hexamerous verticils appears quite incontestible. In this respect the *Anonaceæ* would resemble the *Ranunculaceæ*, having the pieces of the androceum sometimes arranged in whorls, sometimes in spirals.[1]

6. The form of the stamens, the relative size, direction, and position of the anther-cells and connective, especially with regard to the prolongation of the latter, are of great, though not quite absolute, value in separating genera.[2] There is no reason for hesitating very much before placing a species in one genus rather than in the neighbouring one because its stamens are those of the *Uvarieæ*, not of the *Miliuseæ*, or the reverse. We have seen how BENTHAM & HOOKER go much further, at the very outset relegating all the *Anonaceæ* with stamens of the *Miliuseæ* to a separate tribe, though the other characters of the flower are extremely variable in the different genera of this tribe. Adopting their standpoint, we should perhaps need to adopt a third type of staminal organization—that so well marked in the group *Clathrospermum* of the genus *Popowia*. Here the stamens present certain characters of the *Uvarieæ;* for it is impossible to class *Popowia* in the same division as the *Miliusæ;* but yet *Clathrospermum* proper has been put in the latter category.[3]

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[1] The study of development will alone finally settle this question. The numerous stamens of the *Anonaceæ* like those of the *Dilleniaceæ*, might well be originally arranged in bundles. (For the chief details concerning the arrangement and the varying number of the pieces of the androceum, see *Adansonia*, viii. 312–329.)

[2] We have seen, for instance, that certain *Anonas* may be considered to possess stamens of *Bocagea* (p. 222), and that in *Anaxagorea* the connective often recalls that of several species of *Miliusa* by its elongated form, and by being flattened and tapering at the apex (p. 207).

[3] See *Adansonia*, viii. 314.

7. The transformation of certain stamens into sterile petaloid blades.[1]—This transformation is not of generic value, for there is no genus in which all the species present it. In *Aberemoa*, in *Unona*, it occurs in a single species; as well as in a few American species of *Xylopia*. It takes place, as we have seen, sometimes with the outer stamens, sometimes, but far more rarely, with the inner ones.[2] But in this order it does not seem to be due to cultivation.

8. The conformation of the upper part of the receptacle.—We may distinguish the form of complete concavity, with epigynous insertion of all the floral appendages exterior to the pistil, from that in which the concavity is restricted to the summit of the receptacle, or to a region not involving the insertion of the perianth, which in this case is always hypogynous and inserted below the androceum. Accordingly, while complete concavity has sufficed to mark out one particular series, the *Eupomatieæ*, the partial deformity may vary from species to species in one and the same genus. The deep sac on whose outer surface the stamens are inserted in most species of *Xylopia* may become a slight pit, or even a plane surface in some.[3] The same diversity is found in *Artabotrys*,[4] *Hexalobus*, &c., though in these genera the cavity is never so marked as in certain *Xylopias*.

9. The ascending or descending direction of the ovules.—It will be seen that this has no more importance here than in any other group, when we have to deal with numerous ovules arranged along the whole length of the ventral angle of the ovary. In the same species, in the same ovary, here as elsewhere we find ovules nearly horizontal at the centre of the placenta, while they are more or less oblique, ascending or descending, as they approach the top or bottom of the cell. But when the ovules are solitary or few in number we do not

[1] See *Adansonia*, viii. 326.

[2] This peculiarity has been observed in the genus *Anaxagorea* alone (p. 207).

[3] Prof. OLIVER, in his enumeration of the *Anonaceæ* in the *Flora of Tropical Africa* (i. 30), an unpublished work, of which he has kindly favoured me with the proof sheets [this work was published in 1868], has had no hesitation in referring *Melodorum africanum* BENTH., to *Xylopia*, despite its convex receptacle. This has nearly the same form in most species of *Habzelia*, which we have included in *Xylopia* (p. 219); and *X. malayana* HOOK. F. & THOMS., in this respect affords a transition between these and the other species of *Xylopia*, its receptacle being like an elongated cone solid for about two-thirds of its height, with the upper third alone hollowed into a shallow pit to receive the insertion of the carpels.

[4] Especially in the species of the section *Parartabotrys*, such as *P. hexagyna* MIQ. The surface on which the carpels are inserted is flat, but it rises in a circle all round, projecting to a fair height in proportion.

so much expect to find such differences of direction. The ovules of *Phæanthus* and *Ellipeia* are horizontal or slightly ascending, though inserted some way up the placenta. That ovules should be ascending or nearly erect when there are one or two nearly basilar, is yet more intelligible. The micropyle in this case looks outwards and downwards; this we find in *Anona*, *Polyalthia*, certain species of *Trigyneia*, &c. But a good proof that a solitary ovule has not necessarily the same ascending direction in all the species of a genus, is afforded by the plant we formerly called *Trigyneia rufescens*,[1] which has a slightly descending ovule, with the micropyle looking upwards and inwards, though possessing all the other floral characteristics of its congener, the form *lanceolata* of *Anona Perrottetii* A. DC.,[2] whose ovule is ascending. We intend at some future time to make known a third species very near these two, in which the ovule is even more markedly pendulous.

10. The arrangement of the ovules, whether in one or in two rows.—This character can have no great importance, being only determined at a rather advanced age of the gynæceum. At their origin, all the ovules, when numerous, are probably arranged in two parallel rows. It is only later on that those of the one row become interposed to those of the other, both sets gradually approaching the ventral median line. On splitting up the carpel through the longitudinal internal groove, we usually effect a separation of the ovules into two equal sets, one each side of the cleft, though they had appeared ranged in a single vertical row. In certain genera quoted as having sometimes one, sometimes two rows, we have always found two.[3] We shall never use this character to separate two genera. It has no more value in the fruit than in the flower; for ovules that were in the flower arranged in two rows may correspond to seeds superposed in a single row in the fruit, and ovules so close together as to appear in a single vertical row, may develope into seeds arranged in two very distinct ranks.[4]

11. The presence or absence of contractions in the fruit answer-

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[1] *Adansonia*, viii. 180, n. 1.

[2] *Adansonia*, viii. 179, note 5.

[3] In *Hexalobus* for instance, of which all the species are alike in this respect, except *H. madagascariensis* A. DC., which is unknown to us (see p. 227, note 6), and should possibly be referred to the genus *Monodora*.

[4] "The fact of the arrangement (of the ovules) in two rows, probably exists in all cases, but is not always quite so clearly shown; and it is only worth while to base genera on this character when the two rows are very far apart instead of close together. But that does not occur in *Anonaceæ*." (A. DC., *Mém.*, 7.)

ing to false interseminal septa.—This character was formerly used to separate genera; it can be so used no longer. We have passed the day when the *Unonas* were all supposed to present these contractions, then thought to be always absent in *Uvaria;* for in certain of the latter there are more evident marks of dissepiments than in some of the former, and these again may have their fruit with the surface quite smooth and "continuous." The genus *Habzelia* (A. DC.), that was said to be distinguished[1] by its fruits, "here and there irregularly swollen," like those *Unonas* that have irregularly moniliform berries, is at present by all included in *Xylopia;* and hardly is this character thought sufficient to characterize sub-genera in certain genera.

12. The aril.—As we know the origin of the true aril in *Anonaceæ,* we can conceive *à priori* how this organ, formerly thought so very important, can have no real taxonomic value. The soft layer surrounding the coriaceous seed-coat, which is thickened throughout in *Magnoliaceæ,* in *Anonaceæ* only undergoes this thickening around or over the hilum or micropyle, in their interval, or on the sides of the seed. This sort of hypertrophy may even escape notice on a superficial observation, especially in the dry seed, and when it is limited to a small cord bounding the two former regions. The seed has then been described as wanting an aril, though this organ is still represented, for its form and size can have no absolute value. Never have we thought it possible to give a generic value to the character of the presence of the aril.[2]

13. The glandular dots scattered over the surface of the leaves and some other organs.—This fact and its results, as regards the aromatic properties of the *Anonaceæ,* appear to possess some importance in certain genera; for some consist wholly of inodorous species without dots. But here again we have nothing absolute, for in so natural a genus as *Anona* some species are dotted and others are not.

14. The inflorescence.—It is, I think, no longer possible to found genera in *Anonaceæ* on the situation and grouping of the flowers.

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[1] A. DC., *Mém.*, 9.

[2] This was not the opinion of A. DE CANDOLLE (*Mém.*, 8), who moreover stated that the aril, "when present, secretes an apparently resinous aromatic substance at the base of the seeds, often used by man." Here it would seem he confuses the aril and the pericarp itself. According to the same author (1, 3), at the time he wrote, no Asiatic Anonad with a clearly arillate seed was known.

Each genus formerly described as possessing axillary flowers only, now includes species whose flowers are terminal.[1] The flowers are probably always solitary or cymose in this order, and we do not find true racemes. Even the singular fasciated arrangement of the primary peduncles in *Artabotrys* does not appear absolutely constant. In many species of other genera we find both axillary and terminal flowers. Often, again, they are lateral, either owing to the phenomenon of displacement, above called "usurpation," making them leaf-opposed, or because the floral axes are carried to a very variable height with the branch that bears them.

It is by the application of the preceding data on the relative value of the variable characters, that we have been led to modify the classifications as yet proposed for the order *Anonaceæ*, and to trace the following, of which we shall here sum up the main points.

The features which, though quite exceptional, are of primary importance according to most botanists—namely, the general concavity of the whole receptacle, and the union of the carpels into a single ovary—will first of all serve to establish the two following series, which should be placed as far as possible apart from the culminating point of the order, and towards the end of a linear series if this alone can be employed.

Series of the EUPOMATIEÆ.—Carpels inserted within a receptacular sac, like the inflorescence of the Fig. Stamens perigynous (or rather epigynous, in the sense commonly given to the word). True perianth replaced by a bract protecting the flower. Outer stamens alone fertile.

Series of the MONODOREÆ.—Receptacle convex. Ovary superior unilocular, with numerous pluriovulate parietal placentas. Fruit with woody walls, like the ovary, polyspermous. Perianth triple. Corolla of variable form, gamopetalous.

Opposite these aberrant series we place the true *Anonaceæ*, with the floral receptacle at least in part convex, a hypogynous perianth, and a polycarpous gynæceum, the ovaries being really free, no matter whether the pieces of the fruit be so or not at a later period.

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[1] With reference to this we may especially cite the genus *Eupomatia*, which only includes two species. The first that was known has axillary flowers; but this character does not belong to the genus since the discovery of *E. Bennettii*, whose flowers are terminal. This position of the flowers is very exactly figured in SCHNITZLEIN'S *Iconographia* (t. 174); while in the text, the axillary insertion of the flowers is given as a generic characteristic.

From this group we shall first, simply from practical considerations, and not losing sight of the artificial character of the proceeding,[1] take those *Anonaceæ* which appear to possess two calyces and one corolla. The other series, on the contrary, contains those with two corollas and one calyx.[2]

Series of the MILIUSEÆ.—Gynæceum polycarpous. Perianth triple hypogynous. Middle perianth more like the outer than the inner.

Series of the ANONEÆ.—Gynæceum and receptacle of the preceding; middle perianth (outer corolla) more like the inner than the outer (calyx). We have seen that this series is then subdivided according to the conformation of the corolla into five sub-series, as follows:—1. *Uvarieæ*; 2. *Unoneæ*; 3. *Xylopieæ*; 4. *Rollinieæ*; 5. *Oxymitreæ*.[3]

The *Anonaceæ* present great uniformity in the general characters of their vegetative organs. We always find non-herbaceous plants with alternate exstipulate leaves, varying greatly, it is true, in the size, consistency, and duration of the parts. The stem is almost always aerial; in *Eupomatia Bennettii* alone there is a rhizome creeping nearly horizontally below ground, and bearing the aerial branches. The arborescent *Anonaceæ* are nowhere stated to attain to any great size. The largest trunks in any collection are about as thick as a man's thigh. There are in this order a large number of shrubs or little bushes which divide into fascicled branches from the level of the ground; and in very many exotic species we find this arrangement so well shown in our cultivated *Asimina triloba*. Often, again, the stems or slender branches of the *Anonaceæ* twine round neighbouring objects, and many species are described as creepers or climbers. Has this peculiarity any influence on the anatomical structure of the stem? We must answer in the negative, but only as regards those species we have had the opportunity of studying. Except a rarefication of the cortical parenchyma, to form spaces in the centre of the masses of cellular tissue between the rows of liber bundles, we have found the same structure in the branches of the climbing and in the non-sarmentose species of *Anona*, *Unona*, and

[1] See *Adansonia*, viii. 309.

[2] Except when one corolla disappears. It is usually the inner one; in *Enantia* alone is the outer corolla absent. But in all these plants there are only three sepaloid leaves.

[3] The characters on which these divisions are based are, with one exception, those used by BENTHAM & HOOKER, the only difference being the relative importance assigned to these groups; for we term *sub-series* what they have called *tribes*.

Uvaria.[1] It is especially in *Asimina triloba*, a species of this last genus, that we have been able to study the tissue of the stem and branches in the recent state, and this tissue we shall describe, remarking that, generally speaking, it is that of the other genera we have examined.

The pith consists of two kinds of cells; first, we have those of the common parenchyma of Dicotyledons, all nearly similar, irregularly polyhedral, the cell walls riddled with holes;[2] secondly, we have *stony* or *sclerous* cells, analogous to those of the pith of *Magnolieæ*, forming incomplete transverse diaphragms here and there. Their walls are very thick, traversed by numerous canals slightly dilated at each end; they refract light strongly, and are white or yellowish in colour.[3] The wood, rather light and soft,[4] consists of narrow fibres with very minute perforations and vessels of every kind. Certain cylindrical thin-walled vessels, much larger than the rest, are remarkable for their very numerous perforations, placed close together so as to form many rows, covering the whole surface of the vessel, and almost touching by their areolæ.[5] These are circular or elliptical

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[1] We should point out one exception, a *Melodorum* which GRIFFITH (*Notul.*, iv. 707, t. 650) has described under the name of *Cyathostemma*. In this plant, says the author, "the wood is remarkable, the pith very small. The ligneous system white, subcruciately 4-lobed, with concave sinuses, and a secondary brown zone surrounding this, filling up the concave sinuses, but very thin opposite the angles. The vessels of the white lobes are large, and frequently the medullary rays are pronounced, complete, and white in both systems, very large towards the circumference, and generally containing one or two linear bundles of white wood. These rays are distinct, continuous from bark to pith; the spaces between them (*i.e.*, the wood) consist of fine dense fibres, with a nearly simple zone of (scalariform) vessels. The brown part consists of transverse subundulate lines of woody fibre, and transverse oblong spaces filled with brown matter. These brown spaces are divided by septa; and probably the chief difference between the brown wood and the white is that in the brown the vessels predominate so much as to subdivide or break up the continuity of the fibrous part." [In transcribing this passage from the original, I have been compelled to make some alteration, especially in the punctuation, in order to make it intelligible.—TRANS.]

GRIFFITH has described in the same work three other genera of *Anonaceæ* under the names of *Pelticalyx*, *Fissistigma* (706), and *Nephrostigma* (717); but from his very imperfect description of these genera it is almost impossible to discover if they would be included in any of those we have studied above. Perhaps *Pelticalyx* should be referred to *Uvaria*, and *Fissistigma* to *Melodorum*.

[2] Their contents are very variable. Here, as in so many other plants, they are at certain seasons gorged with starch-granules. We also find crystals, either globular and studded with little pyramidal points, or distinctly and regularly octahedral.

[3] Their contents are often yellow, oily-looking. We have seen these thick-walled cells forming diaphragms in the young branches of all the *Anonaceæ* cultivated in our conservatories, *Anona muricata* and *Cherimolia*, *Artabotrys uncata* and *intermedia*, and especially *Xylopia æthiopica*, where they presented very numerous distinct perforations with everted orifices.

[4] DE MARTIUS has given the specific gravity of the wood of several Brazilian *Anonaceæ* (*Fl. Bras.*, *Anonac.*, 64). He gives the following figures:—*Pindaiba preta*, of Saint Paul (*Guatteria flava ?*), ·839 (wood dense, yellowish, flexible); *Araticu do Mato* (*Rollinia sylvatica*) ·530 (paler and softer); *Pindaiba branca*, of Saint Paul (*Xylopia sericea* or *frutescens*), ·626 (colour browner); *Anona crassiflora*, ·574 (wood spongy, whitish).

[5] We have met with these vessels in all the species enumerated above, in many of which the wall looks exactly like a sieve very regularly perforated, and with the areolæ touching by their circumferences.

according as the openings of the pores are rounded or more or less elongated. The medullary rays are numerous, forming very distinct septa, and consist of muriform rectangular cells, much elongated in the radial direction of the stem.[1] Their walls are very thick, regularly studded with narrowly areolate perforations. These rays pass distinctly from the wood into the bark, and in transverse section they are seen isolating the divisions of the liber, which is of a characteristic nature in *Anonaceæ*. In each of the divisions referred to are several concentric sheets of liber fibres produced in the same year. Each sheet is wholly separated from the two respectively internal and external to it, by a band of cellular tissue.[2] After several years these alternating bands of prosenchyma are very numerous, becoming narrower as they are more external, so that in transverse section the segments of liber are nearly rectangular, but later on they elongate in the radial direction, and assume the form of a trapezium with the external base very short. Hence results also a deformation of the cortical cellular masses continuing the medullary rays of the wood, which become also trapeziums, but with the larger base outside.[3] As these external masses enlarge, the cells composing them elongate transversely, but grow very little in the radial direction; each finally becoming a long curved parallelopiped, with its convexity outwards. Their contents are for the most part colourless, but those of several cells bounding the liber bundles on each side usually contain a little chlorophyll. This is very abundant in the true herbaceous layer; the suber, on the contrary, early becomes brown, and its flattened cells are rapidly pushed out towards the periphery of the bark. Those covering the liber bundles project more at the surface than those answering to the parenchyma between them, thus producing alternate ridges on the surface of the bark, indicating the arrangement of the bundles

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[1] DE MARTIUS says (*loc. cit.*) that the medullary rays of the stem of *Anona crassiflora* consist of thick cells, and that the wood is in part made up of large pellucid cells, perforated by linear rows of pores.

[2] Internally the bands of liber formed by the transverse section of their fibres are nearly rectangular and continuous. Towards the outside they become more irregular, and more or less rounded externally, while they are often segmented into two or three parts by little cellular partitions directly continuous with the parenchyma of the herbaceous layer. This irregularity is very well marked in the stems of *Monodora*, otherwise constructed as in other *Anonaceæ*.

[3] In the twining stem of *Uvaria argentea* BL. these surfaces even come exactly to form triangles placed with their vertices in alternate directions, and fitting into one another all round the stem. It is those consisting of parenchyma only that are placed vertex inwards.

of liber within, though not quite so distinctly marked out. In a longitudinal and tangential section of the bark we find each bundle forming a broken line, whose segments are pretty nearly equal and inclined to one another at very obtuse angles, also nearly equal. On examining one of these bundles we find that it touches the two bundles at its sides alternately. The vertex of one of its angles meets the vertex of an angle on the bundle to its right; that of its next angle meets that of an angle on the left-hand one. The vertex of the third angle touches one on the right again, and so on. Thus is formed a network with vertically-elongated, lozenge-shaped meshes, something like a trellis, whose rhomboidal openings are bounded by liber bundles, and are filled up with those transversely elongated cells described above. This arrangement is represented on the surface by an unbroken network with little vertical clefts, the peculiar arrangement of which is often useful as indicating the bark of an Anonad at a glance.

All this, however, only refers to the true *Anonaceæ*, to plants belonging to our three first series. But in *Eupomatia*, which is on other grounds an aberrant type, there are also great differences in the histological structure of the axis. In the bark of a young branch of *E. Bennettii* F. Muell., we have found a thick parenchyma,[1] whose cells are full of chlorophyll granules, or here and there contain a homogeneous pink liquid; while there are numerous independent liber bundles, crescent-shaped in transverse section. But we no longer find the liber forming lozenge-shaped meshes, nor its bundles projecting; the outer surface of the bark is smooth, except for the two decurrent parenchymatous crests, continuing the angular edges of each petiole down the stem. The pith consists of a single sort of cells, thin-walled and riddled with pores.[2] The wood alone retains the character observed in certain *Polycarpicæ*, especially *Drimydeæ*. The fibres are thick-walled, and bear longitudinal rows of areolate pores, which are circular, or more frequently elongated and oblique. At the point of contact of two adjoining fibres we find enormous biconvex, lens-shaped cavities, each resulting from the apposition of two areolæ;

[1] *Adansonia*, ix. 21.

[2] These considerable differences in the stem structure between the true *Anonaceæ* and the *Eupomatieæ* correspond, as we know, to great dissimilarity in the organization of the flower, and confirm the view that *Eupomatieæ* are indubitably more closely allied to the *Monimiaceæ* than to the *Anonaceæ* themselves.

one might fancy them the pores of a Conifer. The woody fibres of the roots present the same appearance. These roots are tuberculate cylinders, like the subterranean swellings of a *Dahlia.* Their thickness results from the great development of the cortical parenchyma. The cells are all similar, and gorged with starch-granules, which we also find in the pith and the numerous medullary rays that connect it with the cells of the herbaceous layer.

The chief characters of this order once known, we can inquire into its affinities, which are numerous. In the first place, it is more or less closely allied to the whole of ENDLICHER'S class *Polycarpicæ*, especially to *Magnoliaceæ* and *Menispermaceæ ;* and generally to those orders which possess ternary flowers. As we have seen, the sole difference between the true *Magnoliaceæ* and *Anonaceæ* is in the seed provided with an arillary thickening, generalized in the former, localized or absent in the latter ;[1] while the albumen is not truly ruminate in *Magnoliaceæ*,[2] as it is in *Anonaceæ*. This character is no longer sufficient to completely differentiate these from *Menispermaceæ*, for the albumen is deeply partitioned in plants of the latter order.[3] But the habit, the size of the flower, the inflorescence, the structure of the stamens and fruit supply, as BENTHAM & HOOKER[4] have shown, sufficient means to separate the two groups in practice. The *Lardizabalaceæ*, now placed near *Berberidaceæ*, have by this very fact closer relations with *Papaveraceæ* than with *Anonaceæ*. *Dilleniaceæ* have not the trimerous or dimerous flowers of the *Anonaceæ*. The Nutmeg order has always been considered nearly allied to *Anonaceæ* on account of the aril and ruminated albumen. These resemblances must now-a-days be considered as only very specious. The apetalous flowers, the mode of diclinism, the monadelphous stamens, are the chief reasons for removing the much-reduced type of the *Myristicaceæ* from *Anonaceæ*. Together with *Magnoliaceæ* the order most

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[1] The aril disappears in *Schizandreæ*, which have also been compared with *Anonaceæ* on account of the type of the flower, and the habit of *Sageræa*, *Stelechocarpus*, &c. The known *Schizandreæ* have all unisexual flowers.

[2] SPACH (*Suit. à Buffon*, vii. 493) does not admit this differential character in all its rigour, for, says he, the perisperm "is anfractuose or rimose in several *Magnolias*."

[3] Especially in *Burasaia*, whose albumen is deeply ruminated, and which we were the first to refer to *Menispermaceæ* (*Adansonia*, ii. 316).

[4] "*Bene limitantur habitu, inflorescentia, floribus parvis, staminibus, et præsertim semine* (*etiam in illis quibus albumen rectum et ruminatum*) *circa endocarpium intrusum peltato-curvato v. sulcato, et embryone elongato.*" (*Gen.*, 30.)

nearly allied to *Anonaceæ* is, in our opinion, *Monimiaceæ,* including therein the *Calycantheæ.* *Eupomatia* is a type which very closely links together the alternate-leaved *Monimiaceæ,* and the *Anonaceæ* with a more or less concave floral receptacle.[1] Of *Monopetalæ, Ebenaceæ* have been always noted as presenting close analogies with *Anonaceæ;*[2] but this conjunction seems to us hardly warranted by an exact analysis of their structure; it is based on superficial characters only.

The *Anonaceæ* are almost exclusively inhabitants of hot climates. They extend over the whole world for about 40° on each side of the equator; but in Africa they hardly pass 20° N. Europe is the only quarter of the world in which none are indigenous; the few species cultivated in the open air being those from North America. The sections *Porcelia* and *Asimina* of *Uvaria* belong to the United States, Mexico, and the western regions of South America as far as Peru. The south-east of this American zone, as far as the south of Brazil, is the country of *Aberemoa, Rollinia, Cymbopetalum, Oxandra,* and most species of *Anona;* indeed it is not long since only one *Anona* was known to be truly indigenous in the Old World.[3] Now, it is true, we know of several;[4] but their number is, on the whole, very limited, compared to that of the species from tropical America.

De Martius has written some remarkable pages[5] on the history of the *Anonas* cultivated in South America. He asserts that *Anona Cherimolia, muricata, obtusiflora,*[6] *reticulata,* and *squamosa* have been imported into Brazil, first cultivated near dwellings, and so gradually modified. Moreover, this author proves by historical and philological reasoning that none of these plants is native in the East Indies, but that all have equally been introduced into the Old World after the discovery of America, and that the Antilles are their true cradle. Thus A. de Saint-Hilaire is mistaken in saying that the *Anonas* with edible fruits,[7] especially *A. squamosa,* come from the East Indies, and

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[1] See *Adansonia.* ix. 17.

[2] See especially Agardh, *Theor. Syst.*, 128: "Ebenaceæ *sunt* Anonaceæ *gamopetaleæ, carpellisque in pistillum unicum confluentibus.*"

[3] See *Adansonia,* viii. 380. We consider *A. senegalensis* Pers., *glauca* Schum. & Thönn., *chrysopetala* Boj. as simple varieties of a single species. *A. palustris* L. is a maritime species, probably from America.

[4] The *Flora of Tropical Africa* includes two other new indigenous species—namely, *A. Barteri* Benth. (*Linn. Transact.*, xxiii. 477), and *A. Mannii* Oliv. (Hook., *Icon.*, t. 1010).

[5] *Fl. Bras., Anonac.*, 51.

[6] It must be borne in mind that this species really belongs to the genus *Rollinia* (see p. 224). It is, therefore, of American origin, like all the plants of the same genus.

[7] *Pl. Us. des Brasil.*, n. 29, p. 5.

that the Portuguese introduced them from thence into their American colonies; for that species is found in Asia with all the appearance rather of a naturalized plant.[1] Now-a-days, more than ever, does R. BROWN's opinion,[2] as to the American origin of the *Anonas* cultivated for their fruits, seem to prevail.

Cananga belongs to both the east and the west of America, from the south of Mexico to the south of Brazil; it is very abundant in Guiana, the Antilles, and Peru. The sections of *Unona, Trigyneia* and *Unonastrum,* also belong to this region.

Besides *Uvaria, Unona,* and *Anona,* four other genera are common to both hemispheres:—*Xylopia, Bocagea, Anaxagorea,* and *Phæanthus. Xylopia* is distributed over the largest geographical area; it has representatives in tropical Africa, Madagascar, India and the Indian Archipelago, Polynesia, the Antilles, Guiana, and as far as the south of Brazil. The genus *Bocagea* consists of several Brazilian species and all the *Alphonseas* of tropical Asia; a single species inhabits the Comoro Isles. *Phæanthus* is disseminated over a wide area, one species coming from Brazil, two from tropical Africa, and as many from the Indian Archipelago. *Anaxagorea* is about equally divided between the tropical regions of Asia and America.

All the other *Anonaceæ* belong to the Old World. *Eupomatia* is essentially Australian. We only find *Monodora* and *Hexalobus* proper in Madagascar and tropical Africa; *Enantia* and *Cleistochlamys* are exclusively African. The following genera have as yet only been observed in tropical Asia or the neighbouring parts of Oceania:—*Sageræa, Sphærothalamus, Cyathocalyx, Disepalum, Atrutregia, Mitrephora, Orophæa;* while in both tropical Asia and tropical Africa we find *Popowia, Miliusa, Oxymitra, Artabotrys,* besides two genera that are, as we have seen, represented in America, *Unona* and *Uvaria.*

The two last-named genera extend over the largest area from north to south, both approaching the extreme limits of the zone 80° broad that the *Anonaceæ* occupy. Both commence in the North of India and finish in Australia with the last representatives of the order. The genus *Uvaria* goes as far north as China and, by *Asimina,* as the United States; and as far south as the boundary line of the *Anonaceæ* at the southernmost point of Australia.

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[1] A. DC., *Géogr. Bot.*, 860.

[2] *Congo*, 6; *Misc. Works*, ed. BENN., i. 105.

Artabotrys also extends to China; and *Rollinia* in the opposite direction towards the river Plata.

In fine, of the twenty-eight genera retained by us, sixteen belong exclusively to the Old World and five to the New; the former comprising one hundred and twenty species, and the latter ninety.

The seven common genera contain 230 species, of which 140 belong to the Old World; which consequently has altogether 260 out of about 400 species of *Anonaceæ* at present known.[1]

The uses of the plants of this order are numerous, especially in the warm regions, where they grow abundantly. They are often aromatic, and consequently stimulant, stomachic, sometimes bitter, tonic, febrifuge, and antiputrescent. But the exaggeration of these properties may also sometimes render their employment dangerous; their delicious perfume may be replaced by acrid, irritating, nay, sometimes even fœtid odours.[2] We shall review the chief useful and noxious species.

The fruit of the American *Uvarias* is edible but little esteemed. That of *U. tribola*, the *Assiminier*, *Monin*, or *Papaw* of the United States (figs. 225, 226) is not of a very agreeable savour. Nevertheless an alcoholic drink can be obtained from it, and is manufactured at Pittsburg. The pulp and bruised leaves are applied to ulcers to induce cicatrization, and to abscesses, whose maturation it is supposed to hasten. The seeds are acrid, like those of many *Anonaceæ*; reduced to powder they are used as an emetic, or to destroy vermin in children's heads.

Several Asiatic *Unonas* and *Uvarias* are used as stimulant drugs. From their bark and pulp are prepared decoctions, applied locally for bruises and rheumatic pains, and administered as stomachics to facilitate digestion. Sometimes these barks are acrid and nauseous, and their use may be dangerous. BLUME has shown that as drugs

[1] Towards the end of 1862, BENTH. & HOOK. (*Gen.*, 20) estimated their number at about 400. Calculations have been made (SCHLTL., *Linnæa*, ix. 331) respecting the successive increments to the *Anonaceæ*, of which LINNÆUS only knew 12 species. In 1817 PERSOON enumerated 47. DE CANDOLLE'S *Prodromus* (1824) included 122, and A. DE CANDOLLE enumerated 204, eighteen years later. We know of a dozen and a half as yet unpublished species, and the *Flora of Tropical Africa* describes about as many more. There are then at least 470 species of *Anonaceæ* in the regions of the earth at present explored.

[2] See BLUME, *Fl. Jav.*, *Anonac.*—ENDL., *Enchirid.*, 423.—LINDL., *Veg. Kingd.*, 421.—GUIB., *Drog. Simpl.*, ed. 4, iii. 675.—ROSENTHAL, *Synops. Plant. Diaphor.*, 589, 1140.

these barks are especially efficacious in affections primarily arising from obstruction of the portal vein, but that they require to be used with caution, for in excess they will produce vertigo, hæmorrhage, and even abortion. The root of *Unona macrophylla* is very aromatic, and is used by the Javanese mountaineers in infusion, prescribed in variola maligna and typhoid fever. The same people consider that the fruit of *U. subcordata* will cure colic. *Unona* (*Polyalthia*) *macrophylla, U. Kentii, U. latifolia* Bl., *Uvaria argentea* Bl., *moluccana* Kostl. (*Unona Musaria* Dun.), *Narum* Bl. (*U. zeylanica* Lamk.,—*Unona Narum* Dun.) and *zeylanica* L. (*U. Heyneana* W. & Arn., nec Wall.,—*Guatteria malabarica* Dun.), are aromatic species, used as drugs or cosmetics. In tropical Asia the perfumed fruits of *Uvaria Burahol* Bl., *dulcis* Dun., and *heterophylla* Bl., are eaten, as are those of *Unona* (*Polyalthia*) *cerasoides, Corinthi, sempervirens,* species with stimulant tonic aromatic barks, sometimes prescribed in rheumatic affections.

Cananga œtan, or *Uvaria tripetala* Lamk., has very aromatic seeds, used by the women of Amboyna to perfume their bodies. The trunk is incised to extract a juice which, when concreted, forms a white scented gum.

The flowers of *Artabotrys* also are very aromatic,[1] as indicated by the specific names of *odoratissima, suaveolens,* &c. The latter species is known in the Indian Archipelago as *Durie carban*.[2] Its leaves are used to prepare an aromatic infusion, whose good effects in cholera have been related by Blume. Several species of this genus, especially *A. intermedia* Hassk., afford a scented oil, much used as a perfume in Java, under the name of *Minjakkenangan*. The *Arbor nigra maculosa*, of which Rumphius has described the various properties, is probably our *A. uncata*.[3] Many species of the same genus have edible fruits.

The *Canang* of the Moluccas, now cultivated in all warm countries, is *Unona odorata*;[4] it owes this name to the sweet scent of its

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[1] See H. Bn., *Dict. Encycl. des Sc. Médic.*, vi. 261.

[2] Bl., *op. cit.*, t. 30, 31 D.

[3] See p. 225. *A. odoratissimus* R. Br. *Anona hexapetala* L.;—*A. uncinata* Lamk.;—*Unona hamata* Dun.;—*U. uncinata* Dun.; *Uvaria uncata* Lour.; *U. esculenta* Rottl.;—*U. odoratissima* Roxb.; —*Modiri Walli* Rheed., *Hort. Malab.*, vii. 86, t. 86).

[4] Dun., *Mon.*, 107, t. 26 (*U. velutina* Gærtn.;—*U. leptopetala* DC.; — *Cananga odorata* Roxb.;—*Uvaria Cananga* Vahl.;—*U. odorata* Lamk.;—*U. Gærtneri* DC.;—*U. axillaris* Roxb.; *U. farcta* Wall.;—*Cananga sylvestris trifolia prima* Rumph., *Herb. Amboin.*, ii. 197, t. 66;—*Arbor Saguisan* Ray. *Supp. Luz.*, 83;—*Alanguilan* of China Sonn.). (See Lamk., *Dict.*, i. 595, 597; *Ill.*, t. 114, fig. 2.)

flowers, said to resemble that of *Narcissus*. *Borbori*, or *Borriborri*, is a semifluid very aromatic pomatum prepared from these flowers, those of the *Champac*, turmeric, and cocoa-nut oil. This is used to rub the hair and the whole surface of the body, to bring back the heat of the skin, as a cure and prophylactic for fever, especially during the cold and rainy season. GUIBOURT asserts that it is no doubt this oil which is known or imitated in Europe, and sold under the name of *Macassar oil*. In Malaysia this plant is cultivated around dwellings; the flowers are used by the natives to deck their hair, clothes, and beds, and triumphal arches in their marriage ceremonies.

The *Anonas*, usually elegant shrubs, cultivated in nearly all the warm countries of the earth, have fruits that are often prized as aliments or drugs,[1] under the general name of *Corossols* and *Cachimans*. One of the best known is the *Pomme Cannelle, Atte*, or *Sweet-sop*, the fruit of *A. squamosa*,[2] a native of the Antilles, cultivated for its fruit in all the tropical regions of both worlds. This is a large ovoidal or nearly globular berry, with a soft white flesh and a greenish, yellowish, or greyish coat, tougher than the flesh and divided into a certain number of obtuse, irregularly lozenge-shaped, scaly projections (figs. 267, 268). Its perfume is sweet and its taste very agreeable. It has been compared to that of a very ripe but somewhat watery pear, and possesses a more or less decided aroma of cinnamon. With the expressed juice may be prepared an agreeable fermented drink like cider. The young fruit is astringent, and the seeds are acrid; for ROYLE reports that they are used, powdered and mixed with chick peas, to destroy vermin; they are employed by the Brazilians for the same purpose, as are those of several *Anonas* and *Rollinias*.

The berry of *A. Cherimolia*[3] (*Chérimolier du Pérou*), a large

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[1] MART., *D. Anonac. usu*, in *Fl. Bras.*, *Anonac.*, 59.—GUIB., *Drog. Simpl.*, ed. 4, iii. 675. — DUCH., *Répert.*, 178.—H. BN., *Dict. Encyl. des Sc. Médic.*, v. 223.—ROSENTH., *Syn. Pl. Diaphor.*, 592.

[2] L. *Spec.*, 757.—JACQ., *Obs.*, i. 13, t. 6.—DUN., *Mon.*, 69.—DC., *Syst.*, i. 472; *Prodr.*, i. 85, n. 14. The fruit is variably named *Cachiman* or *Atocire*, *Marie-baise*, *Sweet-sop* or *Sugar-apple* of the English colonists, *Ata*, *Ati* of the Indians, *Ate*, *Ahate de panucho* in Mexico, and in India it is misnamed *Custard-apple* (which is really the fruit of *A. reticulata*). According to OVIEDO it is called *Anon*. "Hence," says A. DE CANDOLLE (*Géogr. Bot.*, 861), the generic name *Anona*, which LINNÆUS changed into *Annona* (victuals), objecting to any name from barbarous languages, and having no dread of puns."

[3] MILL., *Dict.*, n. 5.—DC., *Syst.*, i. 474; *Prodr.*, n. 17.—*A. tripetala* AIT., *Hort. Kew.*, ii. 252.—SIMS. *Bot. Mag.*, t. 2011.—*Guanabanus* TREW, *Pl. Sel.*, t. 49.

globular or ovoidal syncarpium as big as the fist, with a mammillated surface like the preceding, greenish without, and with a whitish flesh within, is, according to some travellers, the most exquisite of fruits; its gelatinous pulp possesses a delicate flavour of strawberry and pineapple. Like most of the edible *Anonas* this species is cultivated in all warm climates; and might be grown, it is asserted, in the South of Europe. Nevertheless, Father FEUILÉE's opinion of the best Custard-apples applies to this fruit also, viz., that none is equal to our exquisite European pears. They are all much prized in tropical regions, but must be eaten when just ripe. They are already overripe when they fall off the tree; gathered too soon they are astringent, and the tougher outer layers are then too rich in resinous matters and essences, giving the fruit an after-flavour of turpentine. They are no doubt refreshing, but are often injurious to invalids, especially the feverish, who find them "too raw" and indigestible. Before they are ripe they are only eaten with the addition of a certain quantity of sugar; they are then more tonic, owing to their astringency. Usually they are far less nutritious for their bulk than our indigenous fruits, containing a larger proportion of water. The expressed juice is sweet and mucilaginous; fermented it produces a sort of sweet wine called "*vin de Corossol*" in the Antilles. This drink does not usually keep well, turning sour very readily. As stated above, the fruit when incompletely ripe is slightly astringent; it is then better tolerated by the alimentary canal; otherwise it may arrest digestion, and aggravate instead of alleviating the disordered functions. In Peru the young fruit is prized as an astringent drug; its decoction and powder are prescribed in cases of diarrhœa and dysentery.

The fruit of *Anona reticulata*[1] is the *Custard-apple*,[2] otherwise known as *Corossol réticulé* or *sauvage*, *petit Corossol*, *Cachiman*, *Cœur-de-bœuf*, or *Mamilier*, a large globular or oval berry, whose surface, covered by a network with more or less distinct irregular pentagonal meshes, is of a reddish yellow or tawny colour. This fruit is edible, but, it is said, not much esteemed.[3] The leaves

[1] L., *Spec.*, 757.—SLOANE, *Jam.*, t. 226.—JACQ., *Obs.*, i. t. 6, fig. 2.—DC., *Syst.*, I, 474; *Prodr.*, n. 18.

[2] This is the true *Custard-apple* of English colonists; it is cultivated in Mauritius, the East Indies, and Brazil. ROXBURGH says that it is called *Noona* in India, and believes it to be identical with *A. asiatica* LOUR. (nec L.).

[3] It is very heating according to TUSSAC (*Flor. Antill.*, v. 1, t. 29).

have a strong narcotic odour; and the juice that flows from the cut branches is acrid, and inflames the conjunctiva if dropped into the eye.[1] As a drug the green fruit is employed just like that of *A. muricata*.[2]

The fruit of *Anona muricata*[3] is the *Sour-sop*, *Corossol* or *Cachiman épineux*, *grand Corossol* or *Sappadille*; a large ovoidal, or more rarely nearly globular berry, often unequally grown, with straight or hooked points more or less thickly distributed over its surface (fig. 271). Its weight may reach 4½ lbs. (two kilogrammes). The greenish or yellowish surface forms a sort of peel, with a smell of turpentine and a disagreeable taste; this is easily removed to disclose a whitish pulp of buttery consistency and pleasant subacid flavour, recalling at once strawberry, pineapple, and cinnamon. Its smell has been compared to both apples and pears. It has been found to contain tartaric acid. The ripe fruit is eaten with or without sugar;[4] or it is fried or boiled as a vegetable when not more than a quarter of its full size. From the expressed juice, mixed with sugar, is prepared a fermented drink in two days; this does not keep well, but when it turns sour becomes excellent vinegar. The fruit is also used in medicine; when ripe it is supposed to be an antiscorbutic and febrifuge; besides, picked before maturity, dried and powdered, it is administered in cases of intestinal flux or dysentery, when the inflammatory symptoms have been removed by appropriate treatment.[5] A decoction of the green fruit is used topically to the aphthæ of children. From the leaves are prepared poultices, as from those of *A. reticulata*. The flowers, leaf-buds, and leaves, are also, it is said, pectoral and demulcent. The seeds are astringent.

De Martius also points out *A. Pisonis*[6] and *Marcgravii*[7] as *Anonas* with edible fruit. The decoction of the green fruit of the latter is also used in Brazil in the treatment of aphthous stomatitis.

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[1] This is relieved by lemon-juice.

[2] It is used as an astringent in Saint Domingo. In tropical Asia it is cooked, when green, like a head of artichoke, for which it is substituted in sauces. The root is used in India in the treatment of epilepsy.

[3] *Spec.*, 756.—Jacq., *Obs.*, i. 10, t. 5.—Dun., *Mon.*, 62.—DC., *Syst.*, i. 467; *Prodr.*, n. 1.—Tuss., *Fl. Antill.*, t. 24.

[4] It is used to prepare creams and other delicacies. According to Forskhal & Sonnerat (see ii. 3), *A. muricata*, cultivated in Arabia, is there called *Kischta*, *i.e.*, cream. The *Pignon* of Senegal spoken of by Adanson (*Voy.*, 47) appears to be *A. muricata*.

[5] M. de Martius (*Flor.* 61) says that it is administered in a dose of about two drachms, in a mucilaginous enema, to which a small amount of opium is added, and that this treatment was recommended to him by La Cerda, a clever physician of Para. Descourtils (*Fl. Méd. des Antilles*, ii. 63) also recommends this drug.

[6] *Fl. Bras.*, *Anonac.*, 5, n. 3.

[7] *Op. cit.*, n. 2.

A. fœtida and *spinescens* are considered good for curing cutaneous ulcers and for maturing abscesses, by the Indians of the provinces of Rio Negro;[1] the bruised pulp of the fruit is applied topically. In these climates a chill of any part of the body is followed by a painful swelling that prevents the use of that part; the Indians remedy this by baths and warm affusions prepared with the bark of *A. fœtida*. The leaves of *A. muricata, reticulata, squamosa, Marcgravii* contain a volatile oil of disagreeable odour, but infused in water or bruised with oil they bring abscesses to a head. The leaves of *A. palustris*[2] have, according to WRIGHT, the same odour as those of the Savin, and possess the same vermicidal properties. The fruit of this species, called *Corossol des marais, de la mer, Pomme de serpent*, is considered as venomous, or at least injurious to the stomach.[3] Its odour is repulsive, and, says PISON, like that of rotten cheese; and the Topinambous think that the sea crabs that eat this fruit become poisonous as an article of food.[4] However the negroes eat this *Pomme de serpent* for want of better, and it appears that in Senegal too the fruit of *A. chrysocarpa*, really the same plant as *A. palustris*,[5] is sometimes eaten.

The seeds of *Monodora Myristica*[6] have nearly all the properties of the nutmeg; hence they are called *Guinea* or *Calabash Nutmegs* (*Muscades de Calabash*). They are, indeed, more pungent, but they serve exactly for the same culinary purposes; and hence it has been conjectured that the negroes of Guinea transported this plant to Jamaica, that they might be able to use the seeds as a condiment as in their native country. The negroes of Guiana also use the fruit and seeds

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[1] MART., *Reise in Bras.*, ii. 555.

[2] L., *Spec.*, 757.—DUN., *Mon.*, 65.—DC., *Syst.*, i. 469; *Prodr.*, n. 6.—A. S. H., *Pl. Us. Brasil.*, n. 29 (*Araticu do brejo*).—*A. uliginosa* L.—*A. australis* A.S.H.—*A. chrysocarpa* RICH., GUILL. & PERR.—*A. Pisonis* MART. (see *Adansonia*, viii. 296, 380).

[3] SLOANE, *Jam.*, ii. 169.—MARCGR., *Bras.*, éd. a (1648), 93.—PISO, *Bras.*, 48.—SOARES DE SOUZA, *Not. do Bras.*, 194 (ex MART., *Fl.*, 61).

[4] DE MARTIUS remarks that at the same season they eat the fruit of the Manchineel, and of *Sapium aucuparium*.

[5] AUBLET (*Guian.*) also points out several *Anonas* with edible fruit. His *A. punctata* (611, t. 247) is, he says, the *Corossol sauvage*, good to eat. His *A. Ambotay* (616, t. 249) is used for its pungent bitter bark, applied in decoction to malignant ulcers. His *A. longifolia* (615, t. 248), which is an *Aberemoa*, has, he says, an edible fruit called *Pinaouia* by the Galibis. A. DE SAINT-HILAIRE also describes in his *Plantes Usuelles des Brasiliens* (n. 29), his *A. sylvatica* (*Araticu de mato*).

[6] DUN., *Mon.*, 80.—DC., *Syst.*, i. 477; *Prodr.*, i. 87.—*M. grandiflora* BENTH., *Linn. Trans.*, xxiii. 474, t. 52, 53.—*Anona Myristica* GÆRTN., *Fruct.*, ii. 194, t. 125, f. 1.—*Xylopia undulata* PAL. BEAUV., *Fl. Owar. et Ben.*, i. 27, t. 16 (excl. fruct.) The multiple fruit represented in this plate is no doubt that of a *Xylopia* (PL., *Ann. Sc. Nat.*, sér. 4, ii. 262). The true fruit of *Monodora Myristica* has only a single cell (see fig. 299, p. 240). For everything relative to the *Monodoras* in general see above, pp. 239–242, and *Adansonia*, viii. 299, 344.

of *Xylopia aromatica* in the same way, and we shall see that in Brazil other species of the same genus supply culinary condiments.

The fruits of many *Xylopias* are used as aromatics. The one longest known for this is the *Guinea Pepper* (*Poivre de Guinée*), the berry of *X. æthiopica*.[1] The fruit of this plant (fig. 261) consists of a woody peduncle swollen into a head, on which are inserted a number of shortly stipitate, nearly cylindrical berries, about as thick as a goosequill, tapering a little at the base, slightly acute or obtuse at the apex, probably smooth on the surface when fresh, but slightly wrinkled by desiccation, and presenting ill-marked, unequal contractions between the seeds. Of these there are from three or four to twelve or fifteen, uniseriate, ovoidal, blackish, and arillate. The pericarp, blackish when dry, and adherent to the seeds by its deep layer, consists of a sort of dried up pulp, with a faint smell of ginger or turmeric, and is of a pungent, slightly musky taste. The seeds possess these properties in a less degree. *Guinea Pepper* has been used as a drug, and the negroes have employed it as a condiment from time immemorial, and prize several other species of the same genus from the Antilles and Brazil for the same purpose. Such are *X. frutescens*[2] and *aromatica*[3] in Guiana, the *Xylopicron*[4] of the Antilles, and *X. grandiflora* and *sericea* of Brazil.

In the pharmacies of Brazil we find the fruits of three of these species of *Xylopia*—viz., *X. grandiflora*, *sericea*, and *frutescens*. In these are large globular cells, full of an aromatic volatile oil, of a pungent flavour like pepper, but more delicate and agreeable to the taste. DE MARTIUS[5] considers these remedies worthy of introduction into our pharmacopœias; they are energetic tonics for the stomach and intestines, on which they have a binding, carminative, and stimulant action. In decoction, combined with *Quassia amara*, they have often appeared a sovereign cure in weakness and atony of the

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[1] A. RICH., *Fl. Cub.*, 53, not.—*Unona æthiopica* DUN., *Mon.*, 113.—*Habzelia æthiopica* A. DC., *Mém.*, 31, n. 1.—*Uvaria æthiopica* RICH., GUILL. & PERR., *Tent. Fl. Seneg.*, i. 9.—*Piper æthiopicum* MATTH., *Comm.*, i. 434.—*Piper nigrorum Serapioni* C. BAUH.—*Habzelia* BAUH., *Pin.*, 412.—*X. undulata* PAL. BEAUV., *Fl. Owar. et Ben.*, i. t. 16 (quoad fruct., 5). According to his synonymy, AUBLET (*Guian.*, 605, t. 243) calls this plant *Waria zeylanica, Bois d'écorce, Poivre d'Ethiopie, des nègres, Maniguette.*

[2] AUBL., *op. cit.*, 602, t. 242. It is the *Jérécou* or *Conguerécou*. The capsule has an acrid taste and a smell of turpentine. The chewed seeds and the bark are pungent and aromatic, and are used as spices by the negroes.

[3] *Unona aromatica* DUN., *Mon.*, 112.—DC., *Prodr.*, i. 91, n. 27.

[4] P. BROWNE, *Jamaic.*, 250.

[5] *Fl. Bras.*, *Anonac.*, 62.

large intestine. If, as is thought by this author, the *Uvaria febrifuga* of HUMBOLDT is really identical with *Xylopia lucida*, this plant not only arrests fever, but cures inflammations of the intestine, and is especially useful in pyrexia arising from debility of the alimentary canal. DE MARTIUS[1] has also informed us that these fruits are gathered before maturity for medicinal use, and that their action is exactly comparable to the Myrtaceous plant known as *Piper jamaicense* [*Allspice* or *Pimento*]. The fruit of *X. sericea* is the best to preserve in the pharmacy, retaining its aromatic virtues the longest. That of *X. frutescens* has a stronger, but less acrid perfume than pepper; it is supposed to act especially on the nervous system and as a diaphoretic.[2] Moreover, a decoction of its fruits with those of the *Galanga* is used to cure fœtid breath and to arrest caries of the teeth. The Brazilians also use it as a condiment to season meat, fish, and many of their common dishes.

The aborigines of that country give the name *Embira* or *Ibira* to certain species of *Xylopia* with textile liber, especially *X. frutescens.*[3] European industry might perhaps render this very useful to manufacture certain tissues. Perhaps, too, the liber bundles of several species of *Cananga* (*Guatteria*) might serve the same purpose. Their wood is not very solid, but is nevertheless used for several articles of domestic furniture. That of the Brazilian species is called *Pindaiba.*[4] Vases are made from that of *Guatteria australis, flava, nigrescens, villosissima.* The flexible branches of several species are used in fishing.[5] DE MARTIUS has given the name *G. veneficorum*[6] to a species that enters into the composition of one of the *curare* [or *wourali*] poisons of equinoctial America. Many species of *Guatteria* and *Xylopia* have a soft spongy wood; that of the roots especially might serve the same purpose as that of *Anona palustris*, which in that country plays the part of cork, and is chiefly collected for making stoppers. Moreover, in certain departments of carpentry

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[1] *Reise in Bras.*, ii. 550.

[2] These fruits should only be used after being dried in the shade. The dose is from six to twenty grains of the powder itself, and twice as much if in infusion.

[3] MART., *op. cit.*, 63.

[4] *Pindaiba*, according to A. DE SAINT-HILAIRE, means a prop for lines. In Brazil are distinguished *P. branca* and *P. preta* (white and black).

[5] It is also for their flexibility that the branches of *Aberemoa* (*Duguetia*) *quitarensis* are made into whip-handles (SCHOMBURGK).

[6] *Op. cit.*, 34, n. 31; *Reise*, iii. 327, and in BUCHN. *Rep. d. Pharm.*, xxxvi. iii. 344. "*Crescit in sylvis sec. fl.* Japurà, *apud Indos qui* Juri *dicuntur, quibus ad veneficium* Urari *adhibetur.*" AUBLET (*Guian.*, 608, t. 244) says that the fruit and leaves of *C. Ouregou* have a pungent aromatic flavour.

might be used the wood of several *Pindaibas*, whose wood is, according to De Martius,[1] rather heavy, as stated above. The same author calls attention to a certain *Aberemoa* (*Duguetia Spixiana*), as having a tolerably dense wood (·70), and asserts that that of the *Pindaiba branca*, of the Province of St. Paul (which is really *X. frutescens* or *sericea*), has a density of ·626, and a somewhat brownish colour. Many species of this genus, such as *X. emarginata*, *frutescens*, are remarkable for the rapidity with which the branches take root when fixed in the ground; and hence are very fit for making quickset hedges.[2]

The *Anonaceæ* are rarely ornamental plants. Their flowers, not usually very striking, have corollas that long remain green, and only grow larger slowly, in some species long after the expansion of the flower. The petals then gradually assume a white, pink, or yellow tint, more rarely chamois colour or orange, or sometimes again, a more decided red, flame-coloured, crimson or carmine. Many are mahogany or chocolate brown; sometimes we find a purple or violet shade, and *Uvaria* (*Sapranthus*) *nicaraguensis* is said to be of a bluish violet. Here the odour of the corolla is fœtid, but in the yellow and brown ones it often recalls the perfume of certain fleshy fruits, or the aroma of the nutmeg, clove, or cinnamon.

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[1] See p. 257, note 4. In Jamaica the wood of *Oxandra lanceolata* (p. 201, note 1) serves for axletrees and other parts of carriages. According to Aublet (*op. cit.*, 610), the wood of his *Aberemoa guianensis* is used for similar purposes.

[2] See *Fl. Bras.*, *Anonac.*, 64.

GENERA.

I. ANONEÆ.

§ I. Uvarieæ.

1. **Uvaria** L.—Flowers hermaphrodite more rarely polygamous or diœcious; receptacle convex, more or less elongated. Sepals 3, free or connate to a variable height, usually valvate. Petals 6, free or connate at the base, equal or unequal, 2-seriate, imbricated; sometimes the inner or outer set finally valvate. Stamens ∞, linear or flattened; connective dilated above the linear extrorse longitudinally dehiscing cells, truncate or ovate, more rarely subfoliaceous. Carpels ∞, more rarely few, grooved internally; style continuous truncate, apex stigmatiferous entire or 2-fid; ovules ∞, more rarely 1, 2, ventral, in two rows, horizontal or subascending; micropyle lateral or extrorse and inferior. Berries of variable form, entire or more or less constricted between the seeds, sessile or stipitate, ∞- or, by abortion, 1-seeded. Seeds subhorizontal; aril scanty or 0; albumen ruminate.—Small trees or shrubs, often aromatic, usually sarmentose, glabrous, or more frequently covered with simple or stellate down; leaves alternate simple exstipulate; flowers arising before or after the leaves, axillary or lateral, more frequently terminal or leaf-opposed, solitary or cymose (*Asia, Africa, tropical Australia, North and Central America*). See p. 187.

2. **Sphærothalamus** Hook. F.—"Sepals 3, imbricated. Petals 6 (imbricated?) spathulate. Stamens ∞; connective dilated and truncate above the cells. Torus globose. Carpels ∞; style very short obtuse; ovules (2 ?) ventral.—A shrub; leaves subsessile ($1\frac{1}{2}$ ft. long), cordate at the base; flowers large (like orange-blossom)" (*Borneo*). See p. 194.

3. **Sageræa** Dalz.—Sepals 3, imbricated. Petals 6, orbicular concave subequal, imbricated. Stamens few; fertile, subdefinite (6–15) short fleshy laterally compressed; connective with an expanded and

truncate or contracted part projecting inwards above the cells; sterile subdefinite, scale-like thick exterior to the fertile ones. Carpels ∞, or often subdefinite (3–6) inserted on the scarcely convex pitted receptacle; ovules ∞, ventral 2-seriate. Fruit of a few subglobose few-seeded berries.—Trees; leaves very glabrous shining (laurel-like); flowers few small axillary cymose and hermaphrodite, more rarely unisexual (*India*). See p. 195.

4. **Tetrapetalum** Miq.—Sepals 2, imbricated. Petals 4, imbricated, 2-seriate. Stamens ∞, imbricated on a convex receptacle; connective truncately dilated above the anther-cells. Carpels ∞, prismatic; ovules ∞, ventral 2-seriate; style short glabrous, grooved longitudinally. Fruit...—A climbing twining tomentose shrub; flowers in dense lateral or leaf-opposed spikes (*Borneo*). See p. 196.

5. **Cananga** Aubl.—Sepals 3, free or cohering at base, valvate. Petals 6, 2-seriate, inner ones nearly equal to or larger than outer, all imbricated or outer set subvalvate. Stamens ∞; connective truncately dilated above anther-cells; receptacle convex, often subglobose, pistilliferous apex truncate flat or slightly concave and subcupuliform. Carpels ∞; ovule subbasilar ascending; micropyle inferior extrorse. Berries ∞, stipitate, 1-seeded.—Trees or shrubs; leaves penniveined; flowers pedunculate, usually solitary, more rarely in small cymes, axillary or lateral, rarely terminal (*N. and subtropical America*). See p. 197.

6. **Aberemoa** Aubl.—Sepals 3, free, more rarely connate at the base, valvate. Petals 6, imbricated 2-seriate Stamens ∞, all fertile, or the outermost sterile petaloid imbricate. Carpels ∞; ovule solitary subbasilar. Berries fleshy or woody, often beaked, free or connate for a variable height.—Trees or shrubs, scurfy or stellately tomentose; flowers solitary or in small cymes, terminal or leaf-opposed, more rarely lateral (*S. America*). See p. 198.

7. **Cleistochlamys** Oliv.—Calyx globose gamophyllous valvate, closed in the bud, finally breaking into a few unequal segments at anthesis. Petals 6, 2-seriate, sessile, imbricated. Stamens ∞, obpyramidal, inserted on a rather convex receptacle; connective truncately dilated above anther-cells. Carpels few, tapering into

minutely capitate linear-oblong styles; ovule solitary subbasilar ascending. Berries oblong stipitate.—A shrub; leaves glabrous very shortly petiolate; flowers small solitary terminal (*Trop. and south-eastern Africa*). See p. 200.

8. **Oxandra** A. Rich.—Calyx short, imbricated. Petals ovate or rotundate, imbricated 2-seriate. Stamens ∞ (of the *Miliuseæ*); connective produced high above dorsal anther-cells. Carpels ∞; ovule solitary. Berries stipitate.—Trees or shrubs; leaves glabrous shortly petiolate; flowers axillary or lateral; bracts ∞, like the sepals but smaller, imbricated in 2 rows, inserted either from the base to the apex of the peduncle or only in an involucre at the base (*Tropical America*). See p. 200.

§ II. Unoneæ.

9. **Unona** L. fil.—Flowers of *Uvaria;* petals generally 3, rarely 2, valvate, 2-seriate; the inner subequal or smaller, rarely wanting, very rarely imbricated. Stamens ∞ (of the *Uvarieæ*); connective globosely or truncately dilated above anther-cells, more rarely elongated subulate. Carpels ∞, more rarely few or 1, on the convex or flat or more rarely subconcave apex of a slightly raised receptacle; ovules ∞, more rarely 1, 2, ventral or subbasilar. Berries stipitate or subsessile, entire or moniliform constricted between the seeds.—Trees or shrubs; often sarmentose, aromatic; flowers solitary or cymose, lateral or terminal (*Asia, Africa, Australia, warm regions of America*). See p. 201.

10. **Anaxagorea** A. S. H.—Flowers of *Unona;* stamens ∞, all fertile; connective produced above anther-cells, or the innermost sterile petaloid. Carpels ∞, more rarely few; ovules 2, height of insertion variable; follicles clavately stipitate, dehiscing by an internal cleft. Seeds 1, 2, glabrous exarillate.—Trees; flowers axillary solitary or cymose (*Asia, tropical America*). See p. 206.

11. **Disepalum** Hook. f.—Flowers of *Unona*, 2-merous. Sepals 2, large. Petals 4, narrowly linear-spathulate incurved towards the apex, standing apart, connected by a hypogynous ring. Stamens and carpels ∞, inserted on subconcave apex of the broad torus;

ovule (1 ?) basilar erect.—A shrub; leaves penniveined; flowers solitary terminal (*Borneo*). See p. 208.

12. **Bocagea** A. S. H.—Flowers usually small; sepals short, free or connate for a variable height. Petals 6, valvate, 2-seriate, outer sessile, inner sessile or more or less contracted at the base. Stamens (of the *Miliuseæ*), definite (3, 6, 9) subdefinite, or ∞, outer ones shorter. Carpels 3–6, or ∞, more rarely 1; ovules either 1, 2, subbasilar, or ∞, ventral 2-seriate. Berries 1–∞, 1–∞-seeded, usually stipitate.—Trees or shrubs; leaves often with pellucid dots; flowers solitary or cymose, terminal or axillary (*Trop. Asia, Islands east of Africa, S. America*). See p. 208.

13. **Popowia** Endl.—Flowers small hermaphrodite, more rarely diœcious. Calyx 3-merous. Petals 6, valvate, the outer sessile, the inner nearly equal or longer, usually tapering at the base, finally spreading or connivent. Stamens, subdefinite, or ∞, the inner coherent side to side in a verticil; outer ones shorter, fertile, or sterile cylindrical capitate or truncate; fertile stamens, unequally obconical or obpyramidal, terete for a short distance at base, or elongated, tapering or flattened; towards the apex thickened rugose or glandular; apex flat or obliquely truncate, more rarely concave; produced inwards into wedges of variable obtusity, more rarely much elongated, more or less oblique; cells sublateral or extrorse, dehiscing longitudinally; locelli 2, oblique or collateral. Carpels subdefinite or ∞; ovules 1–2, subbasilar, or ∞, 2-seriate: style of variable form. Fruit of free 1- or 2–∞-seeded berries, constricted between the seeds.—Shrubs often climbing; leaves usually glabrescent, below glaucescent; flowers axillary or lateral, solitary or cymose (*Tropical Asia, tropical and southern Africa, Islands of Madagascar, tropical Australia*). See p. 212.

§ III. Xylopieæ.

14. **Xylopia** L.—Flowers hermaphrodite; receptacle conical externally staminiferous, apex flattened or slightly concave, more frequently much excavated, lodging the ovaries. Petals 6, 2-seriate, valvate; outer narrowly elongated concave connivent or open, more rarely flattened sessile 3-angular; inner usually included, above tri-

quetrous, more rarely flattened. Stamens ∞ (of the *Uvarieæ*); connective truncately dilated or tapering above anther-cells. Carpels ∞, or 1–6; styles exserted; ovules ∞, or subdefinite. Berries of variable form, continuous, or sometimes contracted between the seeds, often opening on pressure, ∞- or more rarely 1-seeded.—Trees or shrubs; leaves often distichous; flowers axillary solitary or cymose, usually shortly pedicellate (*Asia, Africa, Oceania, tropical America*). See p. 216.

15. **Anona** L.—Flowers usually hermaphrodite; receptacle more or less convex. Sepals 3, free or connate, valvate. Petals 3 or 6, 2-seriate; the outer sessile broad and concave at the base or altogether connivent or spreading; the inner equal to these or smaller, more rarely 0, valvate or imbricated. Stamens ∞; connective dilated truncate or ovate, more rarely tapering above anther-cells. Carpels ∞ on a hemispherical or flattened torus; ovules 1, 2, subbasilar, styles of variable form often cohering at the apex. Berries usually truncate, more rarely rostrate, cohering into a multilocular fruit, more rarely separating—Trees or shrubs; flowers solitary or in small cymes, terminal or leaf-opposed (*America, Asia, tropical and subtropical Africa*). See p. 220.

§ IV. Rollinieæ.

16. **Rollinia** A. S. H.—Flowers of *Anona*; petals usually connate at base into a short cylindrical or globose tube; apex short valvate covering the sexual organs, finally spreading; on outer petals a thick coriaceous spur-shaped laterally compressed dorsal process, apex obtuse; the inner much smaller or 0, exappendiculate. Berries sessile distinct or more usually coherent into a single fruit.—Trees or shrubs; leaves membranous or coriaceous; flowers solitary or cymose, lateral or leaf-opposed, rarely terminal (*warm parts of America*). See p. 223.

17. **Artabotrys** R. Br.—Sepals 3, free, or more or less coherent at base, valvate. Petals 6, subequal 2-seriate valvate orbicular concave surrounding sexual organs, each with a cylindrical or flattened erect dorsal process. Stamens ∞, connective truncately dilated above anther-cells. Carpels ∞, on the convex or horizontal

more rarely shortly cupuliform summit of the receptacle; ovules 2 subbasilar ascending, or ∞ ventral 2-seriate (*Parartabotrys*); style ovate or linear oblong. Berries 1–∞-seeded.—Climbing or sarmentose shrubs; leaves shining; flowers solitary or cymose; peduncles often hard fascicled bent into a hook (*Asia, tropical and subtropical Africa*). See p. 224.

18. **Cyathocalyx** Champ.—Calyx cup-shaped 3-dentate valvate. Petals 6 valvate connivent into a globose hood over the sexual organs; dorsal processes broad petaloid. Stamens ∞ on a convex receptacle; connective conical truncate above anther-cells. Carpel 1 on concave summit of receptacle. Ovules ∞ in 2 rows, apex of style peltate. Berries 1–∞-seeded.—A tree; leaves glabrous, flowers solitary or in small cymes, terminal or leaf-opposed (*Tropical Asia*). See p. 226.

19. **Hexalobus** A. DC.—Calyx 3-sepalous valvate or subreduplicate. Petals 6 (of *Cyathocalyx*), 2-seriate valvate corrugated into folds in the bud, dorsal laminæ membranous reflexed and rather acute at apex. Stamens ∞ (of the *Uvarieæ*). Carpels subdefinite (usually 3, 6) on the convex or flattened summit of the receptacle; ovules ∞ in 2 rows. Berries oblong subentire ∞-seeded.—Trees or shrubs, flowers solitary axillary sessile or pedunculate, bracts 2, lateral valvate involucrant (*Tropical Africa, Madagascar ?*). See p. 226.

§ V. Oxymitreæ.

20. **Oxymitra** Bl.—Sepals 3 free or cohering at base valvate. Petals 6, 2-seriate valvate, the outer flat, ovate or elongated, the inner smaller, at base more or less narrowed and unguiculate, at apex connivent and coherent into a mitre above the sexual organs. Stamens and carpels ∞; ovules 1, 2 (more rarely 3–5) inserted at a variable height. Berries 1- more rarely 2–∞-seeded. Seeds globose glabrous or bristly; more rarely triquetrous-winged.—Trees or shrubs often climbing; leaves obliquely penniveined; flowers axillary or extra-axillary usually solitary (*Asia, Africa, tropical Oceania*). See p. 228.

21 ? **Atrutregia** Bedd.—"Sepals 4, small. Petals 6, 2-seriate

valvate coriaceous, outer ovate acuminate pubescent on both sides; inner much smaller obovate-acuminate coherent around sexual organs. Stamens ∞; connective obtusely acuminate beyond the cells. Torus subglobose. Carpels ∞; style long tapering; stigma terminal 2-lobed; ovules solitary erect.—A shrub or small tree. Leaves acuminate glabrous Flowers solitary axillary or springing from nodes of fallen leaves" (*East of India*). See p. 230.

22. **Mitrephora** Bl.—Flowers hermaphrodite or unisexual. Sepals 3, usually free valvate. Petals 6, outer short ovate, inner unguiculate cohering into an erect mitre. Stamens ∞, more rarely definite (of the *Uvarieæ*). Carpels ∞ (more rarely subdefinite), ovules ∞.—Trees, leaves coriaceous; flowers solitary or more frequently cymose, lateral or terminal (*Tropical Asia, Indian Archipelago.*) See p. 230.

23. **Orophæa** Bl.—Flowers hermaphrodite (of *Mitrephora.*) Stamens ∞, more frequently definite (6–12), short fleshy (of the *Miliuseæ*). Carpels 3–∞-ovulate usually few ventral 2-seriate. Berries 1–∞-seeded; trees or shrubs; leaves small; flowers small cymose axillary or terminal (*Tropical Asia, Indian Archipelago*). See p. 231.

24. **Cymbopetalum** Benth.—Flowers hermaphrodite or unisexual. Sepals 3 short valvate. Petals 6, 2-seriate, valvate; the outer sessile, short; the inner much larger very thick involute cymbiform, apex with an inflexed or obsolete point; base tapering into a short or elongated claw. Stamens (of the *Miliusieæ*) on a convex receptacle. Carpels ∞; ovules ∞ ventral. Berries stipitate oblong obliquely constricted between the seeds, often opening under pressure. —Small trees; leaves membranous, often oblique at base; flowers on long peduncles, often pendulous lateral or terminal (*Tropical America*). See p. 232.

25. **Enantia** Oliv.—Sepals 3, valvate. Petals outer 0, inner 3, opposite the sepals and much longer, thick coriaceous flat or with slightly reflexed margins, narrower and concave at base, erect or subpatulous. Stamens ∞, linear oblong; connective scarcely dilated above short very obtuse anther-cells. Carpels ∞, free, closely packed on a convex pilose receptacle; style short linear-

oblong grooved internally; ovules solitary, erect.—A tree; leaves membranous; flowers solitary shortly pedunculate extra-axillary (*West of tropical Africa*). See p. 234.

II. MILIUSEÆ.

26. **Miliusa** Lesch.—Flowers hermaphrodite or polygamous by abortion of gynæceum. Sepals 3, small, valvate. Petals 6, 2-seriate valvate, the outer minute sepaloid; the inner much larger erect connivent often slightly coherent or very sacciform at base, more rarely cymbiform. Stamens ∞, anthers ovate (of the *Miliuseæ*), extrorse; connective more or less apiculate above the cells. Carpels ∞; ovules 1, 2 or ∞, ventral. Berries globose or oblong 1–∞-seeded. — Trees usually low; leaves usually deciduous; flowers solitary or cymose, axillary or lateral, often arising with the young leaves (*Asia, Indian Archipelago, N. Australia.*) See p. 235.

27. **Phæanthus** Hook. & Thoms.—Flowers (of *Miliusa*) hermaphrodite. Petals 6, 2-seriate valvate, the outer minute subsepaloid; the inner much larger thick coriaceous flat, or scarcely concave just at the base, erect, connivent around the sexual organs. Stamens ∞ (of the *Uvarieæ*). Carpels ∞, on flat summit of a convex receptacle; ovules 1, 2, inserted at a variable height or ∞, ventral; styles dilated at apex, cohering into an obscurely lobed capitate mass. Berries 1–∞-seeded.—Leaves with well marked veins or coriaceous. Flowers lateral or axillary, solitary or cymose (*Asia, Africa, tropical America*). See p. 237.

III. MONODOREÆ.

28. **Monodora** Dun.—Flowers hermaphrodite. Sepals 3, free or coherent at base, valvate, finally reflexed. Petals 6, valvate, coherent at base only or else for some way into a campanulate corolla; equal or dissimilar, the outer spreading more or less undulate, the inner shorter, contracted at base, erect, connivent. Stamens ∞ (of the *Uvarieæ*), on a subglobose receptacle. Ovary superior 1-celled; placentas ∞ parietal ∞-ovulate; style erect, scarcely dilated into a peltate radiating subentire or crenate often marginate stigma. Fruit globose woody ∞-seeded; seeds (of *Unona*)

imbedded in resinous pulp.—Trees or shrubs often climbing; flowers terminal or suboppositifolious on a gemmiferous twig (*W. and E. of Tropical Africa, Madagascar*). See p. 239.

IV. EUPOMATIEÆ.

29. **Eupomatia** R. Br.—Flowers hermaphrodite. Perianth 0. Stamens ∞, perigynous, and carpels ∞, in a spiral within the concavity of the turbinate receptacle. Outer stamens fertile; anthers 2-celled extrorse, dehiscing longitudinally; connective acuminate above the cells; inner sterile petaloid, glandular or not glandular, imbricated; all connate at base, finally deciduous together. Carpels immersed in the torus, free except the very base; ovary ∞-ovulate, the back produced into a horizontal areola; style short, rather prominent internally, apex stigmatiferous capitate. Fruit baccate within the urceolate turbinate receptacle, marginate above; berries ∞, included 1-∞-seeded. Seeds (of the *Anonaceæ*); albumen slightly ruminated.—Shrubs; stem erect or chiefly subterranean; leaves alternate glabrous; flowers solitary terminal or 1, 2, axillary, superposed, accompanied by a leaf bud (*Australia*). See p. 242.

V. MONIMIACEÆ.

I. CALYCANTHUS SERIES.

In *Calycanthus*[1] (figs. 306–313) the flowers are regular and hermaphrodite. For example, let us analyse that of the first species

Calycanthus floridus.

Fig. 306.
Floriferous shoot ($\frac{1}{2}$).

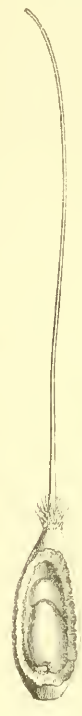

Fig. 308.
Carpel opened ($\frac{16}{1}$).

Fig. 307.
Longitudinal section of flower ($\frac{4}{3}$).

introduced into our gardens (*C. floridus* L.[2] (figs. 306–308), whose

[1] *Calycanthus* L., *Gen.*, n. 639, ex part.—Lindl., *Bot. Reg.*, t. 404.—DC., *Prodr.*, ii. 2.—Nees, *Nov. Act. Nat. Cur.*, xi. 107.—Spach, *Suit. à Buffon*, iv. 281.—Endl., *Gen.*, n. 6356.—B. H., *Gen.*, 16, n. 1.—H. Bn., *Adansonia*, ix. 113.—*Basteria* Mill., ex Adans., *Fam. des Pl.*, ii. 294.—*Beurreria* Ehret, *Pict.*, t. 13.—*Pompadoura* Buch., *Mém. sur le* Calyc., ex Milt., *Handb.*, n. 1805.—*Buettneria* Duham., *Arbr.*, i. 114 (nec L.).

[2] *Spec.*, 718.—Lamk., *Ill.*, t. 445, fig. 1.—Duham., *Arbr.*, i. t. 15.—Ait., *Hort. Kew.*, ed.

receptacle is hollow like a purse, and only open at the top. At a certain height on the outer surface of this sac, we find two opposite bracts, then, higher up, two others also opposite or nearly so, and finally near the margins of the aperture an indefinite number of alternate leaves arranged in a continuous spiral,[1] crowded closer

Calycanthus lævigatus.

FIG. 310.
Fruit.

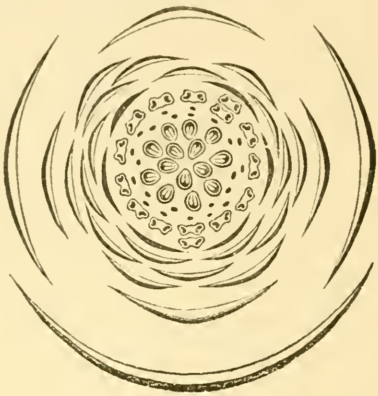

FIG. 309.
Diagram.

FIG. 311.
Longitudinal section of fruit.

together, better developed, and more imbricated as their insertion is higher up. The lower ones are greenish, like the above-mentioned opposite bracts, and the uppermost are brownish purple, fleshy, velvety, and scented like petals, without its being possible to draw any exact line of demarcation between them. The edge of the receptacle then becomes thickened to form a platform covering in its cavity, only presenting a small central orifice for the styles to pass through. On the outside of this lid are inserted

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2, iii. 282.—CURT., *Bot. Mag.*, t. 503.—NUTT., *Gen. Amer.*, i. 312.—GUIMP., *Abb. Holz.*, t. 4.—DC., *loc. cit.*, n. 1.—*C. lævigatus* W., *Hort. Berol.*, t. 80.—*C. oblongifolius* NUTT., *loc. cit.*—*C. inodorus* ELL., *Sketch*, i. 576.—*C. fertilis*, WALT., *Carol.*, 151.—*C. ferax* MICHX., *Fl. Bor.-Amer.*, i. 305.—*C. sterilis* WALT., *loc. cit.*—*C. glaucus* W., *loc. cit.*;—NUTT., *loc. cit.*;—OTT. & HAYN., *Holz.*, t. 5 (most authors consider *C. floridus*, *glaucus*, and *lævigatus* as distinct species).

[1] The index of their angular divergence is $\frac{5}{13}$, so that the fourteenth is exactly superposed to the first; of course it is the same with the stamens, two of which inside the rest are superposed to two others, when there are 15 of them. But their number varies slightly, especially from 12 to 15. So, too, with the other floral appendages. Within the decussate bracts we find from 14 to 18 coloured leaves, and from 5 to 7 large staminodes external to the fertile stamens. L. F. BRAVAIS has pointed out (*Congr. Sci. de Fr.*, 1841, 145) that in *C. floridus* and *ferax* there are several of the decussate bracts, and that "from the last of these starts the floral spiral, which is sometimes simple, sometimes bijugate. In the different pieces of the flower we meet with the spirals 5, 8, and 13."

some leaves still of the colour of petals. But, besides being smaller in every direction, their summit is provided with two little whitish glandular bodies, which in colour and position recall the anthers of the fertile stamens. These come next, internal to the last, but are still arranged on the same spiral as the perianth-leaves : they are not numerous, the usual number being about a dozen or fifteen. Each consists of a short filament and an extrorse anther with two adnate cells, each dehiscing by a longitudinal cleft.[1] Beyond these is prolonged the connective, which ends in a little whitish glandular swelling. Descending towards the interior of the receptacle we find again a certain number of sterile stamens, becoming gradually shorter and shorter, and reduced to coloured tongues surmounted by a little whitish fleshy mass. The indefinite carpels are inserted towards the bottom of the sac. Each consists of a free 1-celled ovary, surmounted by a long slender style dilated at the stigmatiferous apex, passing out of the receptacle, and finally reaching the height of the anthers. In the inner angle of the ovary-cell we observe a parietal placenta bearing two ascending anatropous ovules, of which the one is almost directly above the other when adult ;[2] the micropyle looks downwards and outwards. The fruit is multiple. The receptacular sac forms an indusium, at first slightly fleshy, and finally dry.[3] This sac, whose superior aperture is pretty widely open when ripe, contains an indefinite number of ascending achenes.[4]

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[1] The form of the pollen is peculiar. Each grain is like a flattened rectangular cushion with rather blunt angles; the two longer sides are thickened and obtuse, recurved towards the centre, so as to approach each other on the middle line of one of the faces of the cushion; but there is always a broad cleft-like interval between them. On moistening the pollen these projections disappear entirely; the pollen swells; its angles become obliterated, and the grain soon becomes a smooth sphere or ellipsoid. H. MOHL (*Ann. Sc. Nat.*, sér. 2, iii. 332) gives a veiy different account of this pollen : "ovoidal, three-grooved; in water, ellipsoidal, with three bands vertically and longitudinally compressed."

[2] They are at first collateral, and possess two coats. It usually happens that one ovule afterwards rises considerably and places itself above the other. The latter then increases greatly in the chalazal region (which is superior), and compresses the micropylar region of the former ovule, which becomes deformed and hollowed out below, finally representing a little sterile hood, capping the chalaza of the fertile ovule like an obturator (fig. 308).

[3] On the surface are seen transverse scars corresponding to the outermost leaves of the flowers arranged at regular distances on a spiral. Each scar is placed on the top of a sort of projecting cushion.

[4] The pericarp is membranous and slightly fleshy for some time, finally becoming quite dry, as in the Roses. In *C. lævigatus* the surface only bears scattered hairs, and there is a very slight, scarcely rugose, longitudinal projection, easily visible on the dorsal and ventral median lines of the pericarp, but almost obsolete towards each extremity. In *C. occidentalis* HOOK. & ARN. the whole height of the pericarp is bordered by a longitudinal suberous, rugose projection, covered with hairs which are here short, but, as we shall find, become enormous in the *Atherospermeæ*. The rest of the surface of the pericarp is also sprinkled with down.

Within each is found an ascending seed, whose coats, closely applied to the inside of the pericarp, inclose a very large fleshy embryo with its radicle inferior, and with broad foliaceous cotyledons, spirally rolled on each other round a vertical axis. The albumen is absent or represented by a few rudiments in the folds of the embryo.[1]

The genus *Calycanthus* consists of aromatic shrubs with opposite simple exstipulate leaves.[2] Three species[3] are known, all natives of North America. *C. floridus*, the one we have just analysed, includes several varieties cultivated in this country. Its flowers occupy the

Calycanthus occidentalis.

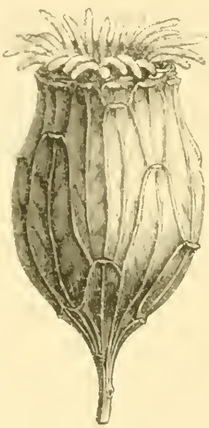

FIG. 312.
Fruit.

FIG. 313.
Longitudinal section of fruit.

axils of the fallen leaves. Each peduncle is provided with two lateral leaves or bracts decussating with the two first bracts borne on the receptacle; and the same axil usually contains, besides the peduncle, a leafy branch, which later on becomes greatly developed, and may even be terminated by a flower.[4] In *C. occidentalis,*[5] the species with the largest flowers, the inflorescence is sometimes axillary, sometimes terminal.

[1] There is especially a little spit of fleshy tissue running up from the chalazal region into the centre of the embryo, and forming, as it were, an axis round which the cotyledons are rolled.

[2] The blade presents the same peculiarities as in *Chimonanthus* (p. 286, note 4).

[3] DC., *Prodr.*, iii. 2.—HOOK., *Bot. Mag.*, t. 4808.—WALP., *Rep.*, ii. 60; *Ann.*, vii. 45.—A. GRAY, *Man.*, 126.—TORR. & GR., *Fl. N. Am.*, i. 475.—CHAPM., *Fl. S. Unit.-St.*, 130.

[4] Thus it is that the flowers of *Calycanthus*, described as axillary, may become perfectly terminal.

[5] HOOK. & ARN., ap. BEECH., 340, Suppl., t. 84.—TORR. & GR., *op. cit.*, 476. In this species, when the fruit is quite ripe, the orifice of the receptacular sac gradually enlarges without any rupture, and the achenes may pass out through this orifice, which is fringed with velvety rods, the hypertrophied staminodes (figs. 312, 313).

Calycanthus præcox L.[1] (figs. 314–317) has a similar organization. Its flowers also have a receptacle formed by a little branch, whose swollen apex has been pushed in so as to make it like a club with

Chimonanthus præcox.

FIG. 314.
Flowering branch.

a concave end. On the whole surface of this are echelonned in order, from below upwards, first of all little brownish, scarious, dry bracts, the lowermost decussate, the upper ones in a spiral.[2] Next

[1] L., *Spec.*, 718.—AIT., *Hort. Kew.*, ed. 1, ii. 220, t. 10.—CURT., *Bot. Mag.*, t. 466.—LAMK., *Ill.*, t. 445, fig. 2.—TURP., *Dict. des Sc. Nat.*, t. 235.—ROXB., *Fl. Ind.*, ii. 672.

[2] There are more of these decussate bracts than in *Calycanthus* proper, but they are similarly arranged, representing undeveloped leaves, and we might here consider the flowers as terminal to a small axillary branch with rudimentary appendages. L. F. BRAVAIS has demonstrated (*loc. cit.*) the presence of from 12 to 18 of these decussate scales. "From the last of these," says he, "there starts a spiral, which includes 20 or 22 leaves, very regularly arranged, and gradually increasing in depth of colour; and then from 5 to 7 stamens, of which the two first are larger than the rest, while the last stamen is innermost."

come other larger, more membranous, petaloid leaves, yellowish or whitish, and sweet-scented; then others again, a little smaller, but quite as thin and delicate, stained with violet purple.[1] So we reach the orifice of the receptacular depression, where several[2] stamens are inserted, with free filaments and extrorse two-celled anthers. Below and within these—that is, nearer the organic apex of the receptacle—

Chimonanthus præcox.

Fig. 316.
Seed.

Fig. 315.
Longitudinal section of flower ($\frac{3}{1}$).

Fig. 317.
Transverse section of seed.

we find sterile tongues, presenting a transition between the stamens and the carpels.[3] The latter, few in number and grouped near this apex, towards the bottom of the receptacular cup, are free, and constructed like those of *C. floridus.* Of the two ovules that each contains, one is more or less completely abortive. The one which alone becomes perfect has its micropyle looking downwards and outwards. If to these characters we add that the flowers of *C. præcox* appear in winter before the leaves are developed (fig. 314), it will be seen why this species and its varieties have been erected into a special genus under the name of *Chimonanthus.*[4] The receptacular sac is

[1] But it is impossible to say where the sepals end and the petals begin, for we find every transition in form, consistency, and colour between the brownish scales, the yellow leaves, and those tinted with purple; even one or two of the outer stamens may become partly petaloid.

[2] *Five* is by far the most usual number.

[3] There are usually from 5 to 8; their form is subulate, and they are solid; no doubt representing sterile filaments, not outer carpels wanting the ovarian cavity; for they are inserted quite close to the fertile stamens, not far from the rim of the receptacle; while there is a large space between their insertion and that of the carpels, which is close to the bottom of the receptacular cup.

[4] Lindl., *Bot. Reg.*, t. 451.—DC., *Prodr.*, iii. 2.—Endl., *Gen.*, n. 6355.—Spach, *Suit. à Buff.*, iv. 285.—B. H., *Gen.*, 16, n. 2.—H. Bn., *Adans.*, ix. 121, 127.—*Meratia* Nees, *Nov. Act. Nat. Cur.*, xi. 107, t. 10. Though several species of this genus have been described under the names of *C. parviflorus, grandiflorus, verus, luteus* (see Bielawski, "*Sur le g.* Chimonanthus *et sa prop.*

like a long-necked gourd,[1] enclosing the true fruits, and closed, as in *Calycanthus* proper (figs. 310–313), by a sort of star with five or six fleshy branches, representing the sterile stamens thickened and approximated to the centre. Each achene contains within its membranous and nearly smooth pericarp an erect seed, of which the embryo is rolled up as in *Calycanthus* (figs. 316, 317).

II. HORTONIA SERIES.

The flowers of *Hortonia*[2] (figs. 318–323) are hermaphrodite or polygamous.[3] In the former case the receptacle is like a cup of variable depth,[4] bearing on its edges the pieces of the perianth and androceum, inserted along a spiral with very close turns. The outermost leaves of the perianth descend even some way down the outside of the oval receptacular cup; they are from six to thirty in number, imbricated, becoming thicker, shorter, and more sepaloid as they are more external, while the inner ones are membranous, petaloid,

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en Anjou," *Ann. de la Soc. Linn. de Maine-et-Loire*, ix. 91), we only admit a single species, *Chimonanthus præcox* (*C. fragrans* LINDL.;—*Calycanthus præcox* L.; — *Meratia fragrans* NEES), with numerous varieties due to cultivation, whether in Japan, its mother country, or in the gardens of other temperate countries where it is abundantly cultivated. Its leaves are studded with glandular dots, and the upper surface is scabrous; this is owing to peculiar hairs which possess the same characters, though less marked in the species of *Calycanthus*. The base of each hair is rather broad and surrounded by epidermic cells converging towards its circumference; the hair then rises like a little curved cone with its tip inclined towards the apex of the leaf. Hence the leaf feels very rough if we rub it towards the base, and quite smooth in the opposite direction.

[1] It bears the numerous scars of the floral appendages; but as the chief increase in size while ripening takes place in the lower part, these scars, close together above, are on the contrary widely separated, linear and transverse, over all the rest of the surface. Within are contained several fertile fruits, besides some sterile achenes. Each of these is borne on a sort of projecting obpyramidal pad, to the top of which it has a linear attachment. In the intervals between the fertile achenes the tissue of the receptacle projects to form a sort of incomplete dissepiments—the first rudiments of those large plates which divide the receptacular cavity into as many compartments as there are fruits in *Siparuna* and certain other *Monimiaceæ*. The down on the surface of the pericarps is much less dense, and the marginal projections are far less marked than in *Calycanthus*.

[2] WIGHT, *Icon.*, vi. 14, t. 1997, 1998.—ARN., *Mag. of Zool. and Bot.*, ii. 545.—ENDL., *Gen.*, n. 4733.[1]—HOOK. & THOMS., *Fl. Ind.*, i. 166.—TUL., *Mon. Monimiac.*, *Arch. Mus.*, viii. 425.—A. DC., *Prodr.*, xvi., s. post., 642, 671.—H. BN., *Adansonia*, ix. 122, 130.

[3] Some are altogether female (TUL., *loc. cit.*), possessing no fertile stamens. There are, on the other hand, entire branches whose flowers have well-developed stamens, while the gynæceum is only represented by little conoidal sterile bodies.

[4] It is sometimes gourd-shaped, like a sac with a somewhat contracted orifice, just as in the Roses and certain species of *Calycanthus*. But its depth is especially dependent on the organs contained in its interior. The fewer the carpels the less marked is the concavity of the receptacle even in the female and hermaphrodite flowers. In the male flowers it is reduced to a cupule of very slight concavity, in *H. acuminata*, for instance. The flower then comes peculiarly near that of certain Anonads, near which *Hortonia* was first placed, while the flowers with very deep receptacles closely recall those of *Peumus* and *Chimonanthus*.

elongated, and strap-shaped. The superior stamens are fertile,[1] each possessing an extrorse two-celled anther, dehiscing longitudinally, and supported on a filament of variable length, bearing at the base two

Hortonia floribunda.

Fig. 318.
($\frac{1}{2}$).

lateral stipitate glands.[2] These are less numerous than the inner stamens, which are reduced to sterile scales placed lower down the inside of the receptacular cup. Towards the base of this are inserted the carpels, indefinite in number. Each consists of a free ovary, tapering above into a style, grooved along the inner angle and stigmatiferous at the narrow apex. Within the inner angle of the ovary is seen a parietal placenta, bearing near its summit a suspended

[1] There are generally from 6 to 10 of these (7-10, Hook. & Thoms.; 8, *plura v. pauciora*, Tul.).

[2] These glands are voluminous, thick, and fleshy, smooth at first, and afterwards flattened and rolled irregularly into cornets.

anatropous ovule, with the micropyle looking upwards and inwards.[1] The fruit is multiple, consisting of a variable number of stipitate drupes. Their stalks are very short and partly hidden by

Hortonia floribunda.

FIG. 319.
Flower ($\frac{4}{1}$).

FIG. 321.
Longitudinal section of flower.

FIG. 322.
Fruit.

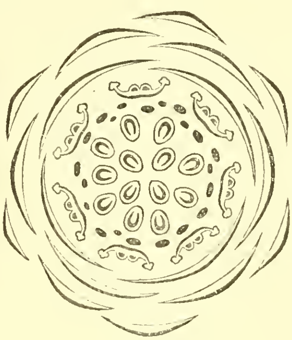

FIG. 320.
Diagram.

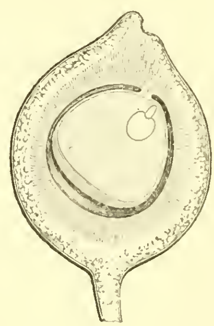

FIG. 323.
Longitudinal section of fruit ($\frac{3}{1}$).

a sheath formed by the receptacle, which persists, covered by the withered pieces of the perianth and androceum, and is sufficiently spreading or reflexed to leave the elements of the fruit free. Each drupe consists of an epicarp and a mesocarp of no great thickness, surrounding a stone that is easily split in half lengthways. This encloses a descending seed containing a copious fleshy albumen, towards the apex of which is a small dicotyledonous embryo.[2]

This genus consists of trees from the East Indies; and two or

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[1] Beside this is sometimes seen another ovule, sterile, forming a little sterile cellular mass.

[2] The axis of this embryo is oblique to that of the carpel (fig. 323), owing to the obliquity of the seed itself. The cotyledons are elliptical or obovate, and membranous, 3-ribbed at the base. The radicle is conical, and its apex corresponds to a small perforation in the albumen, much more marked in *Tambourissa*, *Gomortega*, &c.

three species have been described that grow in Ceylon.[1] Their leaves are opposite, exstipulate, and aromatic. Their flowers are arranged in axillary bunches of cymes, each terminated by a flower, and with opposite decussate divisions. When the hermaphrodite flowers are compared with those of the *Calycantheæ*, we find but few differences between them. In the former the receptacular cup is not so deep, nor when ripe does it envelope the true fruits in a sort of sac. These fruits are drupes, not achenes. The embryo is not rolled up, and is accompanied by copious fleshy albumen; and the ovules, instead of being ascending, are descending; while the micropyle, turned outwards in the *Calycantheæ*, here looks inwards.

In *Peumus*[2] (fig. 324) the flowers are diœcious. The receptacle is like a sac,[3] on whose edges are borne the perianth-leaves, which are imbricated, inserted in a spiral, and gradually modified from within outwards, so that the outermost are thicker, shorter, and covered with the same down as that on the receptacular sac, while the inner ones become more and more glabrous, broader, and more membranous, finally presenting altogether the consistency and colour of a corolla. In the male flowers numerous stamens are echelonned from the throat of the receptacular sac to its lowermost point or organic apex, becoming shorter as they approach it; each consists of an incurved filament with two irregular lateral glands towards its base, surmounted by an anther whose two cells dehiscing by longitudinal clefts, which are nearly marginal, but a little nearer the inner than the outer surface. There are no rudiments of female organs. In the female flower, on the contrary, within the perianth, which resembles that of the male flower, the receptacular sac bears a variable number of narrow acute scales representing sterile stamens. Lower down, near its organic apex, the receptacle gives insertion to a small number[4] of free carpels, each consisting of a one-celled ovary, sur-

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[1] WALP., *Rep.*, ii. 748; *Ann.* iv. 115.—HOOK. & THOMS., *Fl. Ind.*, i. 166.—THWAIT., *Enum. Pl. Zeyl.*, 11.—A. DC., *op. cit.*, 672. It has even been proposed to unite all these plants into a single species.

[2] MOLIN., *Sagg. Sull. Stor. Nat. Chil.* (1782), 185, 350 (ex part.).—A. DC., *Prodr.*, xvi. s. post., 673.—H. BN., *Adansonia*, ix. 123, 126. —*Ruizia* PAV., *Prodr.*, 135, t. 29.—ENDL., *Gen.*, n. 2019; *Icon.*, t. 21 (nec CAV.).—*Boldea* JUSS., *Ann. Mus.*, xiv. 134.—TUL., *Mon.*, 410, t. xxxi., iii.—*Boldu* FEUILL., *Obs. Pl. Med.*, 11 (ex part.).—*Boldoa* LINDL., *Bot. Reg.* (1845), t. 57.—C. GAY, *Fl. Chil.*, v. 351.

[3] This sac is like an inverted cone or funnel; within, and especially towards the lateral walls, it is covered with stiff erect hairs, which persist around the gynæceum after the rest of the flower has fallen; over the perianth they become soft and scattered.

[4] Usually from three to five.

mounted by a style like a little papillose strap, articulated at its base. In the inner angle of the ovary is a placenta, bearing a single descending anatropous ovule, whose micropyle looks upwards and inwards. Scarcely has the flower expanded when the upper part of the receptacle falls off in a circular piece, bringing with it the perianth and the sterile androceum. The base of the receptacle

Peumus Boldus.

Fig. 324.
Flowering branch (male).

alone persists, like a disk bordered with an annular scar, and fringing the base of the multiple fruit. This consists of several very shortly-stalked drupes,[1] containing within the rather thin flesh a very hard one-seeded stone.[2] The seed contains within its membranous coats an abundant fleshy, oily albumen, whose apex is occupied by an embryo with a superior radicle and diverging cotyledons between which the albumen projects like a wedge. Only

[1] At maturity there is very frequently only one.

[2] The mesocarp is very aromatic, and the surface of the stone is unequally tuberculate. The embryo is not, as Lindley thought, totally exterior to the albumen; but this, as represented very faithfully by Tulasne, surrounds the embryo, covering it with a complete layer; it is true that in the upper part this is very thin. The diverging cotyledons cover in a part of the albumen like a roof, the whole of their upper inner surface being directly applied to it. But this is not the true organic apex of the albumen, which is just above the apex of the radicle. As in several other *Monimiaceæ*, a band of the seed coats, corresponding to the raphe, is crustaceous instead of membranous, like the rest, from which it is easily separated.

one species of this genus is known, *P. Boldus*,[1] from Chili, a small aromatic tree, with opposite exstipulate leaves. Its flowers are in axillary and terminal bunches of cymes, with opposite ramifications and pedicels. It has the vulgar names of *Boldu* and *Boldo*. Its structure is, as shown by the preceding description, closely analogous to that of *Hortonia*, from which it only differs in characters of no great value :—the slightly different form of its floral receptacle, the complete separation of the sexes, the introrse aspect of the anthers, the way the female perianth separates from the base of the receptacle after flowering, and the peculiar relations of the embryo to its albumen.

Hedycarya[2] (figs. 325–327) also constitutes a closely-allied genus, rather analogous to *Hortonia* than to *Peumus*, for there is no need

Hedycarya arborea.

FIG. 326.
Female flower.

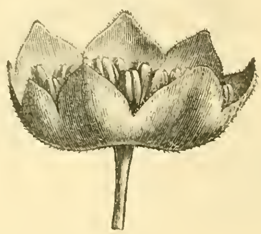

FIG. 325.
Male flower ($\frac{3}{1}$).

FIG. 327.
Carpel opened ($\frac{10}{1}$).

for its perianth to fall off in a ring to free its fruit. This depends on the fact that the perigonium is very short, and that its eight[3] imbricate divisions, quite continuous with the receptacle, form a widely-open cup, which is the same in both male and female flowers. The males have a variable number of stamens (from ten to forty), inserted round the centre of the receptacle, each consisting of a short erect filament, and a basifixed elongated anther, with two nearly lateral adnate cells, each dehiscing by a nearly marginal or slightly extrorse longitudinal cleft. In the female flower a similar perianth

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[1] MOLIN., *loc. cit.* — *P. fragrans* PERS., *Enchir.*, ii. 629.—SPRENG., *Syst. Veg.*, ii. 544, n. 1870.—*Ruizia fragrans*, R. & PAV., *Prodr.*, *loc. cit.*; *Syst. Fl. Per. et Chil.*, i. 267.—*Boldoa fragrans* C. GAY, *op. cit.*, 353.—LINDL., *Veg. Kingd.*, 298, figs. ccv. ccvi.—*Boldea fragrans* TUL., *op. cit.*, 412.—*Boldu, arbor olivifera* FEUILL., *loc. cit.* (excl. t. vi. ex A. DC.).

[2] J. & G. FORST., *Char. Gen.*, 127, t. 64.—L., *Suppl.*, 67.—MURR., *Syst.*, ed. xiv. 894.—C. FORST., *Fl. Ins. Austr. Prodr.*, 71.—J., *Gen.*, 401.—LAMK., *Dict.*, iii. 415; *Ill.*, t. 827.—TUL., *Mon.*, 405 (excl. tab.).—A. DC., *Prodr.*, xvi. s. post., 642, 672.—H. BN., *Adansonia*, ix. 119, 132, 133.—*Crinonia* BANKS ex TUL., *loc. cit.*

[3] This is the commonest number, but there are flowers with only five or six leaves to the perianth; when there are more than eight some of them are smaller than the rest, and often very irregular.

surrounds an indefinite number of sessile carpels, arranged like the stamens, and each consisting of an ovary surmounted by a thick conical style covered with large stigmatic papillæ. The ovary contains, suspended on its inner angle, a single descending anatropous ovule, with its micropyle upwards and inwards. The perianth persists around the base of the multiple fruit, which consists of a variable number of shortly-stalked drupes analogous to those of *Peumus* and *H. ortonia.* Each contains a suspended seed, whose seed-coats enclose a fleshy albumen, surrounding an inverted embryo with a long cylindrical radicle and oval membranous cotyledons.[1] This genus consists of trees with opposite leaves, and diœcious flowers in simple racemes, in bunches of cymes, or in axillary cymes. Five species are known, inhabitants of Australia[2] and the neighbouring regions. One, *H. arborea*,[3] comes from New Zealand, and another, *H. dorstenioides*,[4] from the Feejee Islands, remarkable for a long, dilated, truncate prolongation of the connective, recalling the arrangement seen in the genera of *Anonaceæ* with "stamens of the *Uvarieæ*." This form of anther is also met with in different degrees in the two species from New Caledonia,[5] in which the receptacle is like a very wide cup with its rim much everted, and the calycinal pieces become shorter and more obtuse, while all that is left to mark the perianth in the female flower is a free circular border, entire, or scarcely crenulate or sinuous.

In *Mollinedia*[6] (figs. 328–336) the drupes are also naked, but only

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[1] The direction of the embryo is, as in *Hortonia*, oblique to the axis of the albumen. In a large fruited species from New Caledonia, a large brownish cup-shaped chalaza is observed, applied over the whole base of the albumen.

[2] The Australian species is *H. angustifolia* A. Cunn., *Ann. of Nat. Histor.*, i. 215.—*H. Cunninghami* Tul., *Mon.*, 408, n. 2.—*H. pseudo-Morus* F. Muell., *Trans. Phil. Inst. Vict.*, ii. 62.—*H. Australasica* A. DC., *op. cit.*, 673, n. 2.

[3] J. & G. Forst., *Gen.*, 128, t. 64.—A. DC., *loc. cit.*, n. 1.—*H. dentata* G. Forst., *Prodr.*, 71.—A. Rich., *Fl. N.-Zél.*, 354.—Raoul, *Ch. de Pl. de la N.-Zél.*, 30, 50, t. 30. (Figs. 325–327 are taken from this work.)—Hook. F., *Fl. N.-Zeal.*, i. 219; *Handb. of the N.-Zeal. Fl.*, 240.—Tul., *Mon.*, 406, n. 1.—*H. scabra* A. Cunn., *Ann. of Nat. Hist.*, i. 216.—*Zanthoxylum Novæ-Zelandiæ* A. Rich., *Voy. Astrol. Fl. N.-Zél.*, 291, t. 33.

[4] A. Gray, Seem. *Journ. of Bot.*, iv. 83.—A. DC., *op. cit.*, 673, n. 3.—Seem., *Fl. Vit.*, 206.

[5] H. Bn., *Adansonia*, ix. 132. *H. cupulata* closely recalls *Palmeria* by the form of the receptacle and perianth of the male flower. In the male flowers of *H. Baudouini* especially we see a thick-rimmed cup with a short perianth, and this is even reduced to an obtuse swelling in the female flowers; and if the cup supporting the carpels is of axial nature, we may say that a tendency towards the suppression of the true perianth exists here; and the structure of these flowers also approaches that of *Eupomatia* and the peculiar *Magnoliaceæ* of the genus *Trochodendron*.

[6] Ruiz & Pav., *Prodr. Fl. Per. et Chil.*, 72, t. 15; *Syst.*, i. 142.—Endl., *Gen.*, n. 2019.[1]—Tul., *Mon.*, 375.—A. DC., *Prodr.*, xvi. s. post., 662.—H. Bn., *Adansonia*, ix. 118, 123.—*Tetratome* Pœpp. & Endl., *Nov. Gen. et Spec.*, ii. 46, t. 163.—Endl., *Gen.*, n. 2017.[1]—Crueg., *Linnæa*, xx. 114.

because the perianth of the female flowers comes off in a circular piece (figs. 335, 336) to discover the carpels, which it at first covered completely. In this respect *Mollinedia* is to *Peumus* what *Hedycarya* is to *Hortonia*. The flowers are diœcious,[1] and even in the same species the perianth varies in form with the sex. It forms a globular, turbinate, or nearly campanulate sac, usually split up into four lobes of variable length, imbricated and decussate in the bud. The two outer lobes are not always similar to the inner pair, and sometimes behave quite differently on the expansion of the flower.[2] The stamens are most frequently very numerous, from twenty to sixty in number, inserted over the whole surface of the perigonal sac in vertical rows, two or three superposed to each division of the calyx. Each stamen consists of a short filament first inflexed and then erect, and a basifixed anther shaped like a horse-shoe. Its two cells[3] surround the edges of an oval connective continuous with the filament, and dehisce each by a longitudinal cleft, the two clefts appearing single when the dehiscence is completed. The perianth of the female flower has also an opening whose edges are split into four imbricated decussate lobes. On the bottom of the receptacle formed by the dilatation of the pedicel, we find an indefinite number of carpels crowded together, and resembling those of *Hedycarya*, each with a suspended ovule, whose micropyle looks upwards and inwards (figs. 330, 336). The drupes and seeds are also the same as in the genus *Hedycarya*.

The true *Mollinedias* are of American origin; a couple of species come from Mexico, and the twenty-five others belong to South

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[1] They are said to be monœcious in exceptional cases (BENTH., *Pl. Hartweg.*, 250). They may be incompletely hermaphrodite, either because the female flowers present rudimentary sterile stamens towards the throat of the perianth, or because at the very bottom of the receptacle of the male flowers are contained ill-developed carpels, with, however, a rudimentary ovule in each ovary. This is very marked in most of the male flowers of *M. elliptica* (*M. nitida* TUL.—*Tetratome elliptica* GARDN., *Hook. Journ.*, 1842, 530).

[2] The two inside are often larger, thinner, and with the edges less entire than the two outside, besides being often more reflexed. In the male flowers of *M. ligustrina* TUL. (*Ann. Sc. Nat.*, sér. 4, iii. 44), the four divisions of the calyx, deeply separated from one another, are equal, triangular, and first erect, afterwards spreading. The perianth is campanulate and quadrifid.

[3] They are either exactly marginal, or slightly introrse; more rarely, nearly extrorse. There are really two cells to the anther; but after dehiscence the two clefts, which were at first distinct, coalesce at the apex. In the species with elongated anthers, after dehiscence we see two panels, one internal the other external, each formed of two half-cells, and separating from the other from above downwards; they then take very different forms and directions. The one remains flat or nearly so, or else its very thin edges are reflexed outwards, while the other (usually the inner one) is much more markedly imbricate. The open anther thus presents a conformation that is sometimes very peculiar, and it may appear unilocular.

America, and especially to Brazil.[1] They are trees or shrubs, with the leaves usually opposite, very rarely verticillate. The flowers are arranged in few-flowered, pedunculate biparous cymes, either one or several of which occupy either the axil of a leaf or the extremity of a little axillary branch, itself bearing several leaves at its base.

There are several American species in which the male flowers become oligandrous. *M. elegans*,[2] for instance, has ten or twelve stamens, and sometimes only eight in certain flowers. The allied species form a passage between the American *Mollinedias* and several Old World plants that have been made the types of distinct genera. Their androceum presents, as we shall see, the same diminution in the number of its pieces, but all the other important characters of flower and fruit are the same as in *Mollinedia*, and prevent our keeping distinct the genera that have been named *Kibara*, *Ephippiandra*, *Wilkiea*, and *Matthæa*.

This name *Kibara*[3] has been used to designate plants from tropical Asia, in which the female flower (figs. 328–330) and the fruit are exactly those of the American *Mollinedias*. Their male flowers possess only from five to ten stamens, constructed exactly like those of *Mollinedia*; and the divisions of the female perianth, somewhat variable in number,[4] are doubled by several inflexed laciniate pieces, perhaps representing sterile stamens.[5] The leaves of these trees are opposite, and the diœcious flowers are collected in many-flowered axillary or terminal cymes. No character of any value allows us to consider *Kibara* as other than a separate section of *Mollinedia*, intermediate between the oligandrous American species and the Australian

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[1] Ruiz & Pav., *Syst.*, 141.—Spreng., *Syst. Reg.*, ii. 544.—Schltl., *Linnæa*, xx. 114.—Tul., *Ann. Sc. Nat.*, sér. 4, iii. 40; *Mon.*, 375–399, 402, 403; Mart., *Fl. Bras.*, *Monimiac.*, 313.—Benth., *Pl. Hartweg.*, 250.—Griseb., *Fl. Brit. W.-Ind.*, 9.—Gardn., *Hook. Journ.* (1842) 530; (1845), 136.—A. DC., Seem. *Journ. of Bot.*, iii. 220; *Prodr.*, *loc. cit.*—Walp., *Ann.*, i. 572; iv. 103.

[2] Tul., *Ann. Sc. Nat.*, *loc. cit.*, 44, n. 14; *Mon.*, 398, n. 21.—A. DC., *op. cit.*, 668, n. 25.

[3] Endl., *Gen.*, n. 2016.—Tul., *Mon.*, 403.—A. DC., *Prodr.*, xvi. s. post., 670.—*Brongniartia* Bl., *Bijdraj.*, ii. 435 (nec K.).—*Sciadicarpus* Hassk., *Flora* (1842), *Beibl.*, ii. 20.

[4] There are four or five (as in fig. 329) rarely six. These leaves are thick at the base, entire or very finely ciliate; and reflexed in the bud. The outermost are the shortest, and resemble the bracts situated lower down on the wall of the receptacle.

[5] Their number is either that of the larger leaves, or more frequently greater. We should remark that in the American *Mollinedias* there are often two of the four perianth leaves which become similarly reflexed, the upper bent portion becoming nearly vertical, while they are narrower and less entire than the outer leaves. *M. ligustrina* Tul. (*Ann. Sc. Nat.*, *loc. cit.*, 44) stands almost alone in having all the perianth leaves nearly equal, and equally erect, and afterwards spreading in anthesis (p. 294, note 2).

Wilkieas. Three species of *Kibara*[1] have been described, but it may well be that they are merely varieties of one and the same species, observed in Java, Malacca, Sumatra, and Celebes, with leaves of variable thickness, which may be entire or serrate, acute or obtuse at the apex.

It is worthy of note that as the stamens become fewer, so they tend to lose in length, and that in the oligandrous species of the genus *Mollinedia* the filaments disappear, and the connectives become

Mollinedia (Kibara) coriacea.

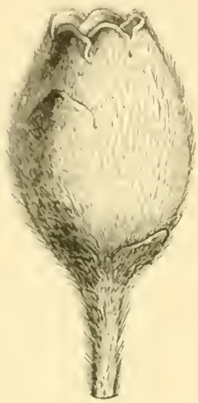

FIG. 328.
Female flower ($\frac{10}{1}$).

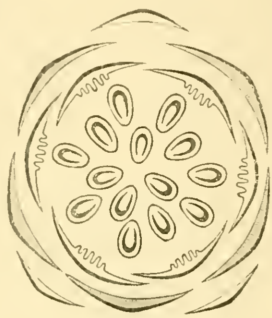

FIG. 329.
Female flower, diagram.

FIG. 330.
Longitudinal section of female flower.

broader than they are long (figs. 332–335). This is especially marked in *Ephippiandra*,[2] a plant from Madagascar, of which it has been proposed to make a special genus. Its female flowers are exactly those of other *Mollinedias*, and the stamens of the male flowers are usually arranged two superposed to the two outer divisions of the perianth, and two to the inner, then two more to the outer, and so on. Owing to the slight elevation of the connective the two anther-cells tend to become horizontal; but their essential structure is the same as in all other species of *Mollinedia*. The most remarkable fact in this species, which allows us to make it the type of a special section, is that, on anthesis, not only do the four divi-

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[1] BL., *Mus. Lugd. Bat.*, ii. 87.—HOOK. & THOMS., *Fl. Ind.*, i. 165.—TUL., *Mon.*, 404.—HASSK., *Pl. Jav. Rar.* (1848), 209, n. 134.—STEUD., *Nomencl.*, 816.—WALP., *Ann.*, iv. 111.—A. DC., *loc. cit.*

[2] DECSNE., *Ann. Sc. Nat.*, sér. 4, ix. 278, t. 7; *Traité Génér. de Bot.*, 517. — A. DC., *Prodr.*, xvi. s. post., 662.—H. BN., *Adansonia*, ix. 124.

sions of the calyx separate from one another, but the receptacular sac splits very regularly down the intervals between the rows of stamens; a phenomenon that we may compare with that observed in many species of *Tambourissa*. The only species of this small group as yet known is a shrub with the foliage and appearance of a Myrtle, and with axillary cymes often reduced to a single flower. The two sexes are on different plants.

Under the name of *Wilkiea calyptrocalyx*[1] has been described a plant with the foliage, female flowers, and fruit of the American *Mollinedias* and *Kibaras*; but its male flowers have at most eleven stamens, according to F. MUELLER.[2] This plant is a native of Australia,[3] and, like the last, may be considered a type of a distinct section in the genus *Mollinedia*. It possesses one or two sterile stamens.

Mollinedia (Kibaropsis) macrophylla.

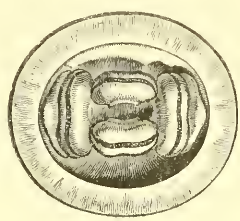

FIG. 332.
Male flower, transverse section.

FIG. 331.
Male flower ($\frac{10}{1}$).

We have given the name *Kibaropsis*[4] to a section of this genus, of which the type is *Mollinedia macrophylla* TUL.[5] Its vegetative organs and female flowers are those of *Mollinedia*, *Kibara*, *Ephippiandra* and *Wilkiea*. But its male flowers (figs. 331, 332) have only six stamens, of which four alone are fertile. These are saddle-shaped, and superposed to the sepals. The two outermost stamens superposed to the outer divisions of the perianth are sterile, and reduced to little fleshy scales. *M. macrophylla* is an Australian tree with Holly-like leaves, and diœcious flowers in small axillary groups.

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[1] F. MUELL., *Trans. of the Phil. Instit. of Victor.*, ii. 64; *Fragm.*, v. 3. A. DE CANDOLLE (*Prodr.*, xvi., s. post., 669, n. 1) makes this plant synonymous with *Mollinedia macrophylla* TUL., of which we shall speak a little later. But these two species, as observed on the typical specimens, seem quite distinct in their vegetative organs. (See *Adansonia*, ix. 123.)

[2] "*Stamina fertilia numeravi* 11 *v. pauciora.*" (F. MUELL., *loc. cit.*) This, again, is a character which decidedly separates this plant from *M. macrophylla*, which, as we shall see, has never more than four fertile stamens.

[3] "*Sylvas littoreas a fluvio* Hastings River *usque ad sinum* Rockingham Bay *sequitur.*" (F. MUELL., *loc. cit.*)

[4] *Adansonia*, ix. 124.

[5] *Ann. Sc. Nat.*, sér. 4, iii. 45, n. 16; *Mon.*, 401, n. 23.—*Hedycarya macrophylla* A. CUNN., *Ann. of Nat. Hist.*, i. 215.—*Wilkiea macrophylla* A. DC., *Prodr.*, xvi. s. post., 669, n. 1. A. DE CANDOLLE, as we have stated above, mentions as synonymous with this plant *Wilkiea calyptrocalyx* F. MUELL., which we regard as distinct (see notes 1 and 2).

Thus we gradually arrive at a species of the same genus, called *Matthæa sancta*[1] (figs. 333–336), in which the androceum presents the greatest reduction known in the number of its elements. This species has exactly the perianth of *Wilkiea* or *Kibaropsis*, but the sterile stamens have disappeared, and we only find four stamens with nearly sessile narrow saddle-shaped anthers, superposed to the perianth-lobes.[2] The female flower and fruit are altogether those of the plants described above. The only known species of this section is a shrub with shortly

Mollinedia (Matthæa) sancta.

Fig. 333.
Transverse section of male flower.

Fig. 334.
Long. section of male flower ($\frac{12}{1}$).

Mollinedia (Matthæa) sancta.

Fig. 335.
Female flower, dehiscing.

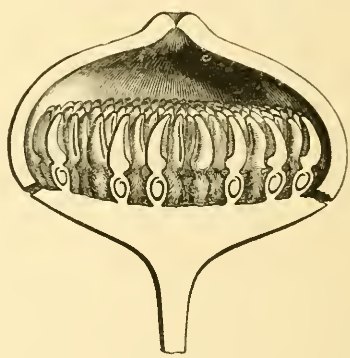

Fig. 336.
Long. section of female flower ($\frac{12}{1}$).

petiolate entire or serrulate leaves, and monœcious flowers in axillary cymes.

In the plants we are now about to study, the fruits, instead of

[1] Bl., *Mus. Lugd. Bat.*, ii. 89, t. 10.—A. DC., *Prodr.*, xvi., s. post., 669.—H. Bn., *Adansonia*, ix. 118, 124.

[2] "*Nonnisi dehiscentia antherarum a* Kibara *differre videtur.*" (A. DC., *loc. cit.*) This dehiscence is the same in both types. The two cells, close together at the apex, each dehisce by a submarginal cleft, but later on the two clefts coalesce above to form a single curved line with its concavity downwards (figs. 332–334). These stamens are exactly like those of *Ephippiandra*, except that the curve formed by the two cells is a little greater, owing to the greater elevation of the connective.

being early freed by the floral sac spreading widely after anthesis, or falling off in a single circular piece, are only discovered much later, for the common envelope which concealed them does not divide irregularly until complete maturity is nearly attained.

In *Monimia*[1] (figs. 337–343) the flowers are regular and diœcious. The male flowers consist of a perianth formed by a nearly ovoidal sac, and a very large number of stamens inserted in a spiral over the whole inner surface of this common envelope. This at first only

Monimia citrina.

Fig. 337.
Male flower ($\frac{6}{1}$).

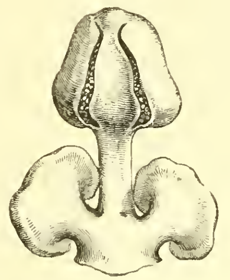

Fig. 339.
Stamen.

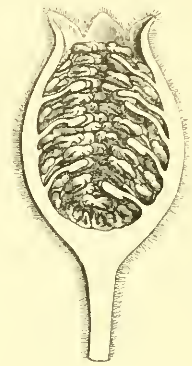

Fig. 338.
Long. section of male flower.

opens by a very small pore at the apex; but on anthesis, it is split downwards from this pore into a variable number of unequal strips which become spreading or even reflexed to discover the stamens (fig. 340). These each consist of a basifixed introrse two-celled anther, dehiscing longitudinally, and a filament of variable length with two lateral sessile or stipitate glands, varying in form with the age and species. The female flowers possess a perianth like that of the male flowers, but with a larger opening at the top, whose margin is divided into several equal or unequal teeth. Through this opening pass the long styles, obtuse and stigmatiferous at the apex, and continuous with the one-celled ovaries, which are inserted towards the bottom of the receptacular sac. The fruit is multiple, consisting of drupes collected

[1] *Monimia* Dup.-Th., *Hist. Vég. Afriq. Austr.* (1804), 35, t. 9.—Endl. Gen., 2015.—Turp., *Dict. des Sc. Nat.*, t. 290.—Tul., *Mon.*, 307, t. xxix. ii.—A. DC., *Prodr.*, xvi., s. post., 661.—H. Bn., *Adansonia*, ix. 117.—*Ambora* Bor., *Voy.*, i. 31, t. 13 (nec J.).—*Myrti* spec. Spreng., *Syst. Veg.*, ii. 487.—*Eugeniæ* spec. Poir., *Dict.*, Suppl., iii. 124.

in a fleshy sac, which, it is said, finally tears irregularly to free them; they consist of a hard, thick stone, surrounded by a thin, fleshy mesocarp. The suspended seed contains within its coats a copious fleshy albumen, with a small embryo towards the apex.

As yet three species are known of this genus,[1] small trees from the islands on the east coast of Africa. Nearly all their organs

Monimia rotundifolia.

FIG. 340.
Male flower expanded ($\frac{6}{1}$).

FIG. 341.
Stamen.

FIG. 342.
Female flower ($\frac{12}{1}$).

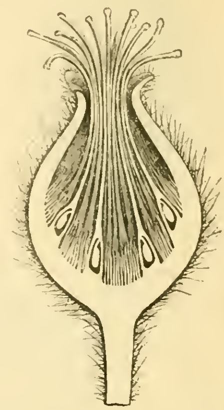

FIG. 343.
Long. section of female flower.

are covered with a peculiar down:[2] the leaves are opposite, petiolate, exstipulate; the flowers are grouped in branching pedunculate axillary cymes.

The flowers of *Palmeria*[3] are monœcious, and nearly similar to those of *Monimia*, especially the females, which are like a sac with a narrow, thick-edged circular border, the aperture being only large

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[1] W., *Spec. Plant.*, iv. 2, 647.—BOJ., *Hort. Maur.*, 289.—TUL., *Ann. Sc. Nat.*, sér. 4, iii. 32; *Mon.*, 309.—WALP., *Ann.*, iv. 88.

[2] Consisting of hairs, often very coarse; sometimes stellate with nearly equal rays, sometimes apparently simple, but really stellate at the base, with a long terminal prolongation, all the lateral rays remaining very short. TULASNE has also seen cystolithes in *Monimia* (see p. 322, note 1).

[3] F. MUELL., *Fragm.*, iv. 152; v. 2.—A. DC., *Prodr.*, xvi. s. post., 641, 657.—H. BN., *Adansonia*, ix. 115, 130.

enough to let the styles pass through. These are numerous, for the whole of the inner surface of the sac bears free indefinite carpels, each consisting of a unilocular ovary, tapering above into a long subulate horn, whose stigmatiferous apex is not dilated. In the inner angle of each ovary is seen a suspended ovule,[1] with its micropyle introrse and superior. The male flowers come much nearer those of *Hedycarya* in the form of their perianth; this is broad and shallow like a dish; the valvate sepals[2] taper towards the apex to narrow points, much inflexed towards the centre of the flower in the intervals between the innermost stamens. Each of these consists of a very short filament, supporting a basifixed erect anther, shaped like an isosceles triangle, with two cells opening by introrse or nearly lateral clefts. The fruit, like that of *Tambourissa*, resembles a little fig, with only a very small pore at the apex, and contains an indefinite number of glabrous drupes, with thin mesocarps and very thick stones.[3] In each stone is a suspended seed;[4] the radicle of the embryo is superior. The drupes are sessile, and inserted by a large base on the surface of the sac; and the spaces between them are thickly covered with hairs.[5] *Palmeria* may then be defined as *Monimia*, with shallow male flowers,[6] and stamens lacking lateral glands. It is believed that the drupes are never freed from the sac forming their common envelope. As yet only one species[7] is known, a native of eastern Australia, a climbing shrub, with slender sarmentose stem, opposite entire leaves, and flowers in axillary clusters of cymes.

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[1] The funicle is usually pretty long. The ovule has two coats.

[2] Of these there are most frequently four, nearly equal. More rarely we find a fifth equal to the others, or narrower. Only exceptionally do we find six perianth-lobes, of which two are very small.

[3] In the dry state they are a little angular, with a finely punctate surface.

[4] In the descriptions given by A. DE CANDOLLE and F. MUELLER, where the seed is stated to be erect, the chalazal mark, which is inferior and very large, has no doubt been mistaken for the umbilical cicatrix.

[5] We find them on almost all the organs of the plant; they are short and simple, or stellate.

[6] The sac enclosing the androeceum is of appendicular nature above; but the basilar portion on which the stamens are inserted is of axial nature, for on it, borne at a variable height, we often find a long bract similar to those seen on the different axes of the inflorescence.

[7] *P. racemosa* A. DC., *loc. cit.*, n. 2.—*P. scandens* F. MUELL., *loc. cit.*;—A. DC., *loc. cit.*, n. 1.—*Hedycarya racemosa* TUL., *Ann. Sc. Nat.*, sér. 4, iii. 45; *Mon.*, *Arch. Mus.*, viii. 409, n. 3 t. xxxiv. i.—WALP., *Ann.*, iv. 113, n. 3.

III. TAMBOURISSA SERIES.

The flowers of *Tambourissa*[1] (figs. 344–351) are irregular and unisexual. In the male flowers (figs. 344, 345), the peduncle is dilated into a hollow, globular or elongated, thin-walled sac, bare on its surface. This has been considered by most authors as a gamophyllous calyx, but is more probably of receptacular nature;[2] the perianth in this genus being only represented by four[3] teeth, usually but little marked, surrounding the orifice at the top of the sac. On its inner walls are inserted the indefinite stamens, larger as they are higher up, and arranged without any apparent order when adult. Each consists of a filament of variable length, and a basifixed anther, whose two linear cells are adnate along the whole length of the edges of a connective continuous with the filament, and are lateral or more or less extrorse. Each cell dehisces by a lateral or nearly lateral cleft, which often coalesces with its fellow at the apex of the anther, so as to form a single line of dehiscence, with a very marked curve whose concavity is downwards. At a certain period, the little teeth surrounding the orifice of the floral sac separate to free the pollen secreted by the anthers. The body of the sac, coriaceous and very

Tambourissa leptophylla.

FIG. 344. Male flower ($\frac{4}{3}$).

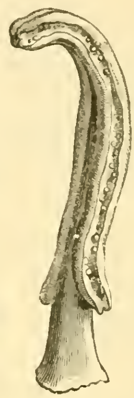

FIG. 345. Stamen.

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[1] SONNER., *Voy. Ind. Or.* (1782), ii. 237, t. 134; ed. 2, iv. 405, t. 134.—GMEL., *Syst. Nat.*, ii. (1791), 16.—A. DC., *Prodr.*, xvi. s. post., 658. H. BN., *Adansonia*, ix. 114, 121.—*Tambourecissa* FLAC., *Hist. de Madag.* (1661), 133, n. 69. —*Ambora* JUSS., *Gen.*, 401, n. 4706; *Ann. Mus.*, xiv. (1809), 130.—POIR., *Dict.*, vii. 565; Suppl. v. 282; *Illustr.*, t. 784.—ENDL., *Gen.*, n. 2014. —TUL., *Mon.*, 295, t. xxv–xxvii.—*Mithridatea* COMM., MSS., ex SCHREB., *Gen.* (1791), ii. 783. —W., *Spec.*, i. p. 1 (1797), 27, n. 24.—SPRENG., *Syst.*, iii. (1826) 866, n. 3132.—*Tamboul* POIR., *loc. cit.*

[2] Which seems proved by the fact, of which we have observed several instances (*Adansonia*, ix. 115), that its outer surface may bear one or several bracts.

[3] This is the most frequent number; but it may vary from three to five or six; and these teeth, which are very unequal, are to be well observed only in the very young bud, where they are thick at the base, with the limbs inflexed and hanging almost vertically downwards at first, the obtuse apex almost reaching the bottom of the receptacle.

thick, in this case seems to remain entire; but more frequently it tears vertically into four, five, or six equal or unequal strips, which

Tambourissa elliptica.

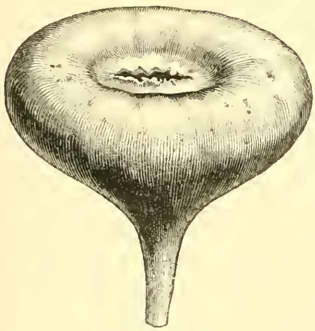

FIG. 346.
Female flower ($\frac{3}{1}$).

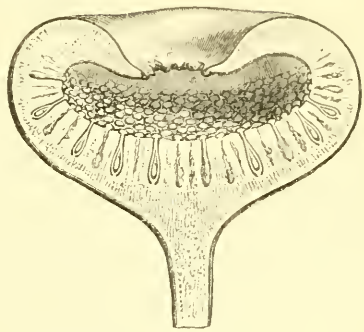

FIG. 347.
Longitudinal section of female flower.

then spread like a star, bearing on their inner surface the stamens dehiscing and shedding their pollen (fig. 344).

The female flower is fig-shaped; its walls are thicker than in the male with the apex usually more depressed, forming a widely open terminal "eye." The opening of this sac-like receptacle is cut up into projecting festoons, usually of very unequal sizes and somewhat inflexed. These ill-marked lobings are the vestiges of the divisions of the perianth, and are better seen when very young. The sac is lined by an indefinite number of carpels, extending from the centre to a variable height on its walls. Each carpel consists of a one-celled ovary, tapering into a short style, dilated and stigmatiferous at the apex. In the inner angle of the ovary is seen a placenta bearing a single anatropous ovule,[1] whose micropyle looks

Tambourissa elliptica.

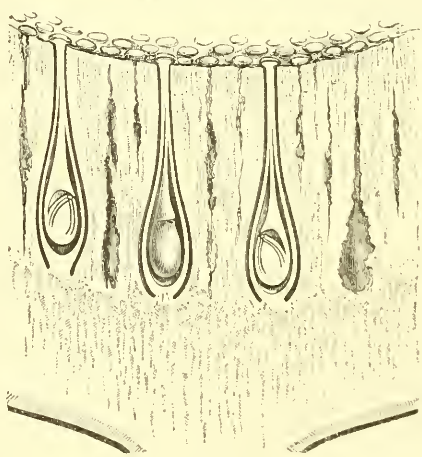

FIG. 348.
Part of the gynæceum ($\frac{25}{1}$).

[1] This ovule has two coats. The exostome is traversed by a short tube, at the top of which is the orifice of the endostome projecting slightly outside. The sharp apex fits into the base of the tube.

upwards and inwards, and is capped by a somewhat hood-shaped protuberance from the elongated funicle. All the carpels, at first free, later become buried in the deep layer of the floral receptacle, which, thickening as it grows older, rises up in the intervals between the ovaries, surrounding them, and later even the styles, as high up as the bases of their capitate stigmas, but not contracting any adhesion with them; so that the stigmas are alone visible on top

Tambourissa quadrifida.

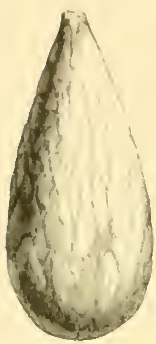

Fig. 350.
Drupe ($\frac{2}{1}$).

Fig. 349.
Longitudinal section of fruit ($\frac{1}{2}$).

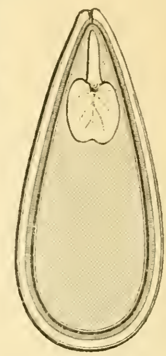

Fig. 351.
Longitudinal section of drupe.

of the narrow canals traversed by the styles. The multiple fruit, in general appearance like the female flower, has more or less fleshy or woody walls.[1] Its receptacle is hollowed out into a number of cavities, each of which contains an ovary in its original position, but now transformed into a more or less compressed drupe (figs. 350, 351). The mesocarp and stone are not very thick, and enclose a suspended seed, containing within its membranous coats[2] a very

[1] These outer forms, it must be remembered, only belong to the indusium formed by the hypertrophied floral receptacle. To free the true fruits, often described by older botanists as the seeds, it is, however, necessary that there should be some solution of continuity in this indusium; in fact, a sort of dehiscence due both to the centrifugal pressure exerted by the growing drupes on the walls of the receptacle, and to the tendency of the receptacular sac to spread out and become less concave (*Adansonia*, ix. 127). Its edges separate and even become inverted, while the superior table (representing the interior epidermis and neighbouring layers of the receptacle) becomes cleft and pushed up irregularly; afterwards the unequal lips of these clefts are reflexed outwards. The true fruit, the drupes, then appear in large numbers on the surface, as the seeds of a pomegranate might do if it burst when ripe; the whole now presenting a bright red colour due to the fleshy part of the pericarps.

[2] They become thicker and slightly crustaceous over the whole region of the raphe, so that when ripe this may easily come off from the seed like a narrow fillet.

copious oily, fleshy albumen, with an apical embryo, whose radicle is superior and cylindrical, and whose cotyledons are broad and flattened.[1]

The genus *Tambourissa* consists of trees or shrubs, with opposite, or rarely alternate,[2] exstipulate leaves. The flowers are diœcious, or more rarely monœcious, axillary or terminal, solitary or collected into simple or cymose racemes.[3] A dozen species[4] are known, from Bourbon, Mauritius, Madagascar, and the neighbouring islands of the Indian Ocean. A single species has been observed in Java.

The remarkable structure of the fruit of *Tambourissa* has led most authors to put the genus into a special tribe[5] of the order *Monimiaceæ*. In this order is another genus, in which we also observe a singular hypertrophy of the receptacular sac in the intervals between the true fruits—the genus *Siparuna*, which we shall now study, and which we include in the same series as the foregoing on account of this peculiarity. Still, it might be placed in a group apart, for its ovules are ascending instead of pendulous, and the compartments inclosing the drupes do not embrace them closely as in *Tambourissa*, but are like unequal irregularly pyramidal chambers, with whose walls the ovaries are not at first in contact, as we shall presently see.

In this genus[6] (figs. 352–356) the flowers are monœcious, or more frequently diœcious. In both sexes the receptacle and perianth are blended to form a sort of sac of very variable form, sometimes rounded and globular, sometimes obconical or obovate, with the

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[1] These are slightly auricled at the base, and may touch one another over the whole of the upper surface; but they are very frequently directed obliquely in opposite directions, so that they do not cover each other completely, but are separated towards their extremities by a large sinus; their planes, however, are parallel, always remaining unaffected by this obliquity. The plumule already consists of several little imbricated leaves.

[2] As in *T. alternifolia* A. DC., *op. cit.*, 660.—*Ambora alternifolia* TUL., *Ann. Sc. Nat.*, sér. 4, iii. 31, n. 8; *Mon.*, 305.—WALP., *Ann.*, iv. 87.

[3] Often as many as two or three of the secondary axes may spring, one above the other, from the axil of a single leaf or bract; thus recalling the arrangement of the floral axes in *Calycanthus*.

[4] SONNER., *loc. cit.*, t. 134.—W., *Spec.*, i. 27.—BOJ., *Hort. Maur.*, 290.—TUL., *Ann. Sc. Nat.*, *loc. cit.*, 29; *Mon.*, 297, t. xxv–xxvii.—A. DC., *Prodr.*, *loc. cit.*—WALP., *Ann.*, iv. 84.

[5] *Sycioideæ* s *Amboreæ* TUL., *op. cit.*, 295.—*Tambourisseæ* A. DC., *loc. cit.*

[6] AUBL., *Guian.*, ii. (1775), 864.—JUSS., *Gen.*, 443.—CRUEG., *Linnæa*, xx. 113; *Ann. Sc. Nat.*, sér. 3, vii. 376.—A. DC., *Prodr.*, xvi. s. post., 642.—H. BN., *Adansonia*, ix. 121, 125, 131.—*Citrosma* R. & PAV., *Prodr. Fl. Per. et Chil.* (1794), 134, t. 29; *Syst.*, i. (1798), 263.—ENDL., *Gen.*, n. 2017.—*Leonia* MUT., ex TUL., *Mon.*, 312 (nec R. & PAV.).—*Conuleum* A. RICH., *Mém. Soc. Hist. Nat. Par.*, i. (1823), 391, 406, t. 25.—SCHLTL., in DC., *Prodr.*, xiv. 608.—*Angelina* POHL, ex TUL., *Mon.* 363.—*Citriosma* TUL., *Ann. Sc. Nat.*, sér. 4, iii. (1855), 32; *Mon.*, 311, t. xxviii–xxx.

outer surface naked or bearing certain projections whose nature we shall examine below. The superior opening of this sac is sometimes circular and simple; sometimes double, presenting an outer rounded rim, entire, or cut up into crenulations, festoons, or even lobes of

Siparuna guianensis.

FIG. 352.
Male flower ($\frac{10}{1}$).

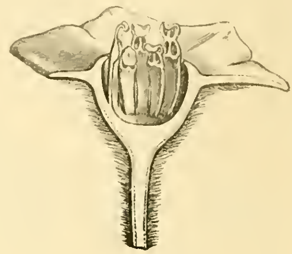

FIG. 353.
Longitudinal section of male flower.

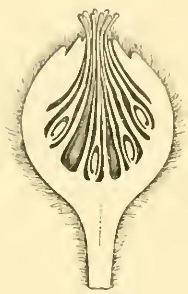

FIG. 354.
Longitudinal section of female flower.

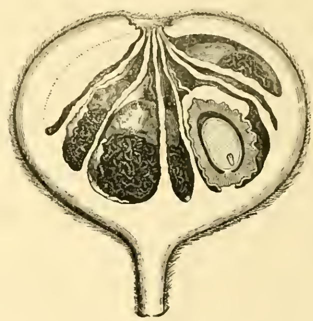

FIG. 355.
Longitudinal section of fruit ($\frac{3}{1}$).

variable depth, and within this rim a "*velum*," or sort of conical roof, raised or depressed, sometimes nearly flat and horizontal. In the centre of this diaphragm is an opening, usually narrow, and sometimes reduced to a simple circular pore on anthesis. This gives passage to the stamens or to the stigmatiferous summits of the styles, as the case may be, while the lower parts of the reproductive organs remain shut in by the perigonal sac, towards the bottom of which they are inserted (figs. 352–354).

The characters of the androceum are peculiarly variable in *Siparuna*, but as we find gradual transitions between the different variations we are about to mention, it has been altogether impossible to split up the genus on that account. The stamens may be very numerous in some species, such as *S. neglecta* &c., while in

others there may be only twice or thrice as many as there are perianth-lobes; and there may be a number equal to these in *S. limoniodora, eriocalyx, subinodora, mollis, plebeja*, &c. In *S. mollicoma, mollis*, &c., the number is even less; some flowers having only four, three, or even two stamens; variations which may occur in a single inflorescence. Usually the stamens are free, as in *S. guianensis;* or the filaments may become broad and almost petaloid, only touching by their edges and seeming to stick to one another as in *S. riparia*, &c. But in *S. mollis* they are really united into two or three bundles, while in *S. mollicoma* they usually form a single tube, long enough to pass out of the opening of the perianth, becoming distinct only close to their summits, just by the insertion of the anthers. The stamens are usually constructed on one common type in all. The filament is like a membranous fillet, flattened, or concave internally. The anther consists of two cells applied to the inside of this, a little below its more or less tapering apex. Each cell opens at first below, where we find two clefts like crescents with the concavity upwards. Later on the inner walls of both cells go on to separate from the cavities from below upwards in a single piece, to form a common plate that is soon quite erect and vertical, or even reflexed outwards; it is still joined to the anther near its apex, while the free extremity, corresponding to the base of the anther, is more or less deeply split into two lobes, each belonging to one cell[1] (figs. 352, 353).

In the female flowers we find a variable number of carpels inserted on the inner surface of the perigonal sac. There may be as many as thirty of these; but usually there are not so many, and in some species we find only three or four. The base by which each is inserted becomes more extended and oblique as it is higher up. The one-celled ovary contains a single basilar ascending ovule with its micropyle downwards and outwards, and tapers above into a style stigmatiferous at the apex. Into the intervals between the carpels the floral envelope sends prolongations to form vertical, or more or less oblique partitions; so that each ovary is contained in a little chamber of its own (fig. 354).

The fruit is multiple; outside it looks something like a small

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[1] The anther is, according to F. Mueller (*Fragm.* iv. 152), like this in *Siparuna, Tambourissa, Monimia, Mollinedia*, and *Atherosperma*, while it is 4-valvular in *Hedycarya*.

apple. This fleshy outside is an indusium formed by the now succulent receptacle; and the partitions between the carpels are similarly altered. The fruits themselves enclosed in the cavities of this sac are drupes, but the pericarp varies greatly in consistency and thickness. In *S. guianensis*, *Apiosyce*, &c., it consists of a hard stone, bristling outside with very prominent woody points. The membranous epicarp is almost in contact with this over the lower two-thirds, where the mesocarp is also reduced to a thin membranous layer. But above, the latter swells and becomes thick and fleshy, so that here the pericarp is that of any ordinary drupe. The kernel is a single ascending seed, with membranous coats, and copious fleshy albumen, containing near its apex a little embryo whose cotyledons are superior (fig. 355).

In the female flower, as in the fruit, the surface of the sac is usually smooth, bearing no other appendages than the pieces of the perianth. But in several species which have been made into a section apart, the surface is covered with a pretty large number of more or less marked projections, of divers forms, which should be considered as prickles (Fr., *aiguillons*—fig. 356).

Siparuna muricata.

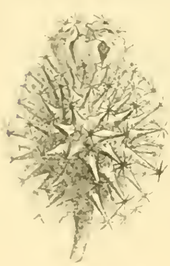

Fig. 356.
Female flower (1/1).

The genus *Siparuna* consists of small trees or shrubs from tropical America, especially abundant in Brazil, Peru, and Guiana. Some are found in the Antilles and Mexico. Upwards of sixty species are already known.[1] Their leaves are opposite, rarely verticillate, aromatic, sprinkled with pellucid more or less projecting glands, sometimes glabrous, sometimes covered, like most of the organs, with a down that may be very thick. The flowers are arranged in axillary cymes, sometimes very regularly biparous, sometimes branching symmetrically only at first, and afterwards becoming uniparous and unsymmetrical by the abortion of one flower in each generation.

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[1] Aubl., *op. cit.*, 865, t. 333.—R. & Pav., *Syst.*, 264; *Prodr.*, t. 29.—H. B. K., *Nov. Gen. et Spec. Pl. Æquin.*, ii. 170.—Pœpp. & Endl., *Nov. Gen. et Spec.*, ii. 47, t. 164.—Spreng., *Syst. Veg.*, ii. 545.—Benth., *Pl. Hartweg.*, 250.—Crueg., *Linnæa*, xx. 113.—Beurl., *Prim. Fl. Port.*, 146.—Tul., *Ann. Sc. Nat.* sér. 4, iii. 32; *Mon.*, 314; in Mart., *Fl. Bras.*, *Monimiac.*, 294.—Griseb., *Fl. Brit. W. Ind.*, 9.—Seem., *Journ. of Bot.*, ii. (1864), 342.—A. DC., Seem. *Journ. of Bot.*, iii. (1865), 219; *Prodr.*, *loc. cit.*, 643.—Walp., *Ann.*, iv. 89.

IV. ATHEROSPERMA SERIES.

We shall begin the study of this series by examining *Atherosperma Sassafras*,[1] which has been made the type of the genus *Doryphora*.[2]

Doryphora Sassafras.

FIG. 357.
Three-flowered cyme ($\frac{3}{1}$).

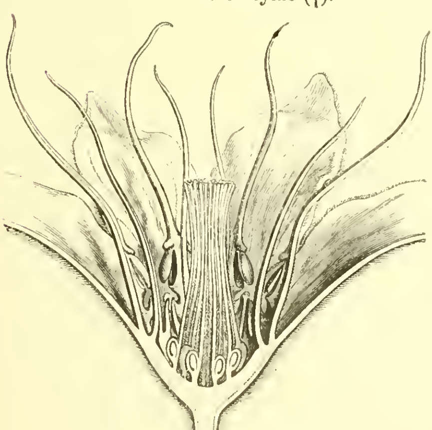

FIG. 358.
Longitudinal section of flower.

FIG. 359.
Stamen ($\frac{12}{1}$).

It possesses regular hermaphrodite flowers (figs. 357–359). The

[1] A. CUNN., *Herb.*, ex TUL., *Mon.*, 424.

[2] ENDL., *Gen.*, n. 2022; *Icon.*, t. x.—LINDL., *Veg. Kingd.*, 300, fig. ccviii.—TUL., *Mon.*, 422.—A. DC., *Prodr.*, xvi. s. post., 642, 676.—H. BN., *Adansonia*, ix. 128.—*Learosa* REICHB., *Nomencl.*, n. 2612, ex ENDL. et TUL., *locc. citt.* This genus may perhaps be rightly made only a section of the genus *Atherosperma*. Its fruit is but little

receptacle forms a rather deep pouch, and in its somewhat contracted mouth is inserted the perianth. This consists of about half a dozen free elongated nearly petaloid caducous leaves, imbricated in æstivation. Internal to these are the indefinite stamens, arranged in a spiral, making several very close turns. The outermost of these stamens are fertile, their number varying; while the inner ones are sterile, becoming shorter and shorter. Each fertile stamen consists of a flattened filament, laterally dilated into two acute membranous petaloid appendages, and of an anther with two slightly introrse adnate cells, above which the connective is continued into a long subulate point. Each cell opens by an oval valve, which is soon uplifted; to its hinge is attached an obtuse scaly projection (fig. 359). The inner stamens have the same form, with a long ligulate connective, lateral appendages, and a dilatation answering to the anther; but the deformed cells no longer contain pollen, and there are no valves for dehiscence. Finally, the smallest stamens are quite rudimentary, reduced to short fleshy scales, without lateral appendages or terminal processes. The indefinite carpels are inserted towards the bottom of the receptacular cavity. They are free, and each consists of a one-celled ovary, surmounted by a linear style inserted more or less on one side, covered with hairs and tapering towards its stigmatiferous apex. In the ovary is a basilar placenta supporting a nearly erect anatropous ovule, whose micropyle looks downwards and outwards. The fruit is said to resemble that of *Atherosperma*. Of this genus only one species is known,[1] a tree from eastern Australia, aromatic in every part. The leaves are opposite, exstipulate; and to them the flowers are axillary, in bunches of biparous cymes, with opposite ramifications axillary to caducous bracts.

The genus *Atherosperma*[2] (figs. 360–370), which has given its name

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known. Perhaps, too, its characters will have to be modified after the study of the flowers of a plant which we have described (*Adansonia*, ix. *loc. cit.*, note 1) under the name of *D.? Vieillardi*, and have only referred to this genus with some hesitation. Perhaps it is the type of a new genus characterized by its campylotropous ovary. ENDLICHER has, indeed, described the insertion of the style as lateral and subbasilar, but has figured a rectilineal, not a curved, ovary. Perhaps the new plant in question will serve as a link between the genus *Atherosperma*, as we now limit it, and the genus *Doryphora*; in its vegetative organs it recalls the section *Laurelia* of the former genus, rather than the latter.

[1] *D. Sassafras* ENDL., *loc. cit.*—WALP., *Ann.* iv. 120.—LINDL., *Veg. Kingd.*, 300, fig. ccviii.

[2] LABILL., *Nouv.-Holl.*, ii. 74, t. 224.—ENDL., *Gen.*, n. 2020.—TUL., *Mon.*, 418, t. xxiv.—A. DC., *Prodr.*, xvi. s. post., 642, 675.—H. BN., *Adansonia*, ix. 122.

to this group, is closely analogous to *Doryphora.* In fact, of the two species that have been hitherto alone admitted in this genus, the one

Atherosperma moschata.

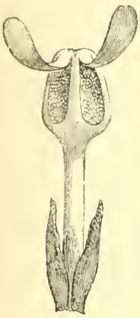

Fig. 362.
Stamen.

Fig. 360.
Floriferous branch ($\frac{2}{3}$).

Fig. 365.
Carpel.

Fig. 363.
Female flower ($\frac{3}{1}$).

Fig. 361.
Male flower ($\frac{3}{1}$).

Fig. 364.
Longitudinal section of female flower.

termed *A. micranthum*[1] has hermaphrodite flowers, similarly organized to those of *Doryphora Sassafras*,[2] from which their only essential

[1] Tul., *Ann. Sc. Nat.*, sér. 4, iii. 46; *Mon.*, 421.—Walp., *Ann.*, iv. 118.

[2] They also recall those of *Hortonia*, especially in the form of the receptacle and the organization of the androceum.

difference is that the extrorse anthers lack the acute prolongation of the connective. The other, which has been longer known, has larger flowers, but usually with the sexes separate; it is called *A. moschata*[1] (figs. 360–365). The receptacle is like a sac, shallower in the male flower. Towards its edges are inserted in a spiral a variable number of imbricated, more or less petaloid leaves.[2] Internally to these the male flowers present an indefinite number of free stamens, inserted nearly down to the bottom of the receptacular cup, each consisting of a filament possessing two lateral appendages at the base, and surmounted by a truncate extrorse anther, each of whose two cells dehisces by the lifting up of a valve. In the female flower the stamens are only represented by some sterile imbricated scales internal to the perianth.[3] At the bottom of the cup[4] are inserted numerous carpels, whose unilocular ovaries are each surmounted by an acute style with a sharp stigmatic summit, and covered with silky hairs (fig. 365). The single cell of the ovary contains a nearly basilar ovule, whose micropyle looks downwards and outwards. The fruit consists of a large number of achenes,[5] which are surrounded below by a large woody capsule formed by the indurated receptacle. The pericarp and a long point surmounting it, formed of part of the style that has grown hard, are covered with long hairs, giving them a plumose appearance. This pericarp is thin and membranous, closely applied to the seed, which contains within its very thin coat a copious oily, fleshy albumen, its base occupied by a small embryo with superior divaricating cotyledons. The two known species of *Atherosperma* are large aromatic trees from the east and south of Australia; and *A. moschata* is also found in Tasmania. The leaves are opposite, entire or dentate; the flowers are axillary, solitary or in simple or ramified cymes; in *A. moschata* each flower is accompanied by two opposite bracts, whose edges are close together when young, and which form a sort of calyx to the flower-bud (figs. 360, 361, 363, 364).

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[1] LABILL., *loc. cit.*—A. DC., *Prodr.*, *loc. cit.*, 676, n. 1.—HOOK. F., *Fl. Tasm.*, i. 42.—*A. integrifolium* A. CUNN., ex TUL., *loc. cit.*

[2] They are arranged in two rows, not well marked out, it is true; and as there are often eight leaves, the four outer ones are more like sepals, and the inner are better developed and more petaloid. In fine, between these we find almost the same progressive dissimilarity as we do between the floral appendages, respectively called sepals and petals in the *Calycantheæ*.

[3] These scales become far more visible in an impregnated flower (as represented in figs. 363, 364), after the perianth-leaves have fallen off or withered.

[4] This is much deeper here than in the male.

[5] In several species of the genus it would probably be better to call them caryopsids, as we have said in *Adansonia*, ix. 125.

From *Atherosperma* it is impossible to separate the *Laurelias*[1] (figs. 366–370) generically. These possess polygamous or diœcious

Atherosperma (*Laurelia*) *Novæ Zelandiæ*.

FIG. 366.
Flower ($\frac{3}{1}$)

FIG. 368.
Diagram.

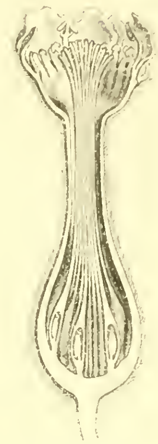

FIG. 367.
Longitudinal section of flower.

FIG. 369.
Fruit ($\frac{4}{3}$).

FIG. 370.
Fruit dehiscing.

flowers. In the hermaphrodite we find a very concave receptacle, like an elongated, narrow-necked gourd. On the rim of this are

[1] JUSS., *Ann. Mus.*, xiv. (1809), 134.—POIR., *Dict.*, *Suppl.*, iii. 313.—SPRENG., *Syst. Veg.*, ii. 470.—A. CUNN., *Ann. of Nat. Hist.*, i. 380.—C. GAY, *Fl. Chil.*, v. 353.—HOOK. F., *Fl. N.-Zeal.*, i. 218.—TUL., *Mon.*, 414.—A. DC., *Prodr.*, xvi. s. post., 642, 674.—H. BN., *Adansonia*, ix. 116, 122.—*Paronia* R. & PAV., *Prodr.*, 127, t. 28; *Fl.*, i. 253.—ENDL., *Gen.*, n. 2021 (nec CAV.).—*Thiga* MOL., ex ENDL., *loc. cit.*

borne the perianth and androeceum, while the carpels spring from the bottom of its concavity. The perianth consists of a variable, never large, number of imbricated leaves, inserted in a spiral (figs. 366–368), and becoming larger and more membranous as they are more internal. The stamens are also indefinite in number, inserted in a spiral making very close turns, and each consisting of an anther with two introrse cells, each dehiscing by the rising up of a valve, and of a filament with two lateral stipitate glands at its base. A little lower down and more internally, the throat of the receptacle bears a variable number of tongue-like appendages, which are no doubt sterile stamens. The carpels are numerous, free, each consisting of a one-celled ovary tapering towards the apex into a slender papillose style. The ovary contains a single erect anatropous ovule, whose micropyle looks downwards and outwards. The fruits are achenes, and the seed-coats enclose an embryo surrounded by oily, fleshy albumen. The style persists on the top of the achene, covered with long silky hairs. All the achenes are enclosed in the persistent receptacle, whose gourd-like form becomes more and more marked. For some time this indusium remains entire; but later on it splits from the apex downwards into a small number of segments, which separate to free the proper fruits (figs. 369, 370).

Certain flowers are wholly female through all the stamens being reduced to antherless tongues; this is frequently the case in *L. sempervirens.* Others, again, are male, since all the carpels remain rudimentary or are altogether absent from the base of the receptacle; in this case it loses much of its depth, which is not so great as its breadth.

Of this section of the genus *Atherosperma* two species are known, the one from Chili, *A. sempervirens*,[1] the other from New Zealand, as indicated by its specific name, *A. Novæ Zelandiæ*.[2] They are tall aromatic trees, with thick coriaceous opposite leaves. The flowers are collected into racemes, simple, ramified, or made up of axillary or terminal cymes.[3]

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[1] H. Bn., *Adansonia*, ix. 116.—*Laurelia sempervirens* Tul., *Mon.*, 416.—C. Gay, *op. cit.*, 355.—*L. aromatica* Poir., *Dict.*, *Suppl.*, iii. 313. —*L. serrata* Bert., *Merc. Chilen.* (15 Jun. 1829).—*L. crenata* Pœpp., *Exs.*, iii. n. 135, ex A. DC., *op. cit.*, 675, n. 1.—*Pavonia sempervirens* R. & Pav., *Prodr.*, t. 28; *Syst.*, i. 253.

[2] *A. Novæ-Zelandiæ* Hook. F., *Handb. of the N.-Zel. Fl.*, 240.—*Laurelia Novæ-Zealandiæ* A. Cunn., *Ann. of Nat. Hist.*, i. 381.—Hook. F., *Fl. N.-Zel.*, *loc. cit.*, t. 51.—Tul., *op. cit.*, 417. —A. DC., *loc. cit.*, n. 2.

[3] *Laurelia* is united by J. Hooker to *Atherosperma*, the only absolute distinction for which

V. GOMORTEGA SERIES.

The flowers of *Gomortega*[1] are regular and polygamous. In the hermaphrodite (fig. 371), we find a concave sac-like receptacle, and on its edges a perianth and androceum, each made up of eight pieces, or perhaps a few more, the number being very variable. The perianth-leaves are in two sets; the outermost are thicker and more hairy, while the inner are broader, more membranous, and more like petals. All are imbricated in the bud. The stamens are also in two whorls. There are usually about four larger external ones, always

Gomortega Keule.

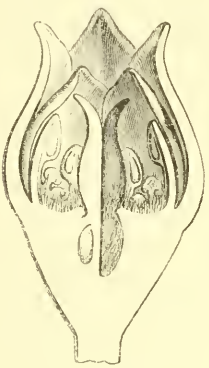

FIG. 371.
Longitudinal section of flower ($\frac{6}{1}$).

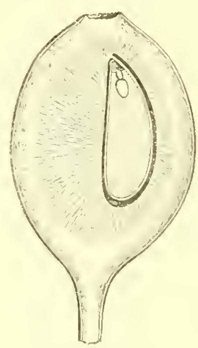

FIG. 372.
Longitudinal section of fruit.

fertile, and each consisting of a filament bearing a basifixed introrse anther, dehiscing by two valves, as in *Atherosperma*. The smaller ones, of which there are as many or a few more, are similarly organized; but the anther may be sterile, and its two valves are imperfectly shown on the inner surface, and do not separate from it. All the stamens possess two unequal, irregular, shortly-stalked glands,

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the former is made into a distinct section being, that its receptacle is cleft longitudinally into unequal segments (figs. 369, 370) nearly as in *Doryphora*. But, in the order *Monimiaceæ*, this character can have no generic value. The time will no doubt come when all the *Atherospermeæ* as yet known will be collected into a single genus, whose only essential differences from *Calycanthus* will be the lateral appendages to the stamens, the copious albumen, and the nonconvolute cotyledons of the embryo.

[1] R. & PAV., *Prodr. Fl. Per. et Chil.* (1794), 108.—H. BN., *Adansonia*, ix. 118.—*Adenostemum* PERS., *Synops.*, i. (1805), 467, n. 1058.—NEES, *Syst. Laur.*, 651.—MEISSN., ap. DC. *Prodr.*, xv. s. i. 67, 507.—*Adenostemon* SPRENG., *Syst.*, 370, n. 1870.—C. GAY, *Fl. Chil.*, v. 303, t. 60 (nec BERTER.).—*Keulia* MOL., ex NEES *loc. cit.*—*Lucumæ* spec. MOL., *Hist. Chil.* (1782) 202.—*Cryptocaryæ* spec. ENDL., *Gen.*, n. 2036, c. (nec R. BR.).

springing from the filament at a variable height. The gynæceum consists of two, or more rarely of three carpels, whose ovarian portions are buried in the concavity of the receptacle, almost entirely united to the thick walls of this sac. The edges of the latter are also very thick, and covered with hairs; they form a projecting rim around the contracted orifice that gives passage to the two or three styles, closely in contact with each other, and each tapering at the apex to a stigmatiferous point. In the internal angle of each ovary may be seen a placenta, bearing towards its upper part a single descending anatropous ovule, whose micropyle looks upwards and inwards. The fruit (fig. 372) is a drupe, surmounted by a cicatrix; its fleshy mesocarp is not very thick; while the stone, made up of the cells of the gynæceum as well as of the deep layers of the receptacle, is alike very thick and very hard. In each of the two or three cells of this stone is a suspended seed, often sterile; but which when fertile is formed as in *Tambourissa* of thin coats, inclosing a copious, oily, fleshy albumen, with a little embryo towards the apex whose radicle projects through a circular opening in the albumen.[1]

As yet only one species of this genus is known, *G. Keale*.[2] This is a large tree from Chili; all its parts are very aromatic. It has opposite exstipulate leaves, and shortly pedicellate opposite flowers, collected at the ends of the branches or in the axils of the upper leaves into simple or, more rarely, ramified racemes.[3] The genus *Gomortega*, hitherto referred to *Lauraceæ*, may be defined as *Monimiaceæ*, in which the ovaries adhere to the receptacular sac to form a drupe whose sarcocarp belongs wholly to the receptacle. These plants, then, stand to the other members of the order in the same

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[1] We have incontestibly established the fact of the presence of a very copious albumen in this genus (*Adansonia*, ix. 126). It appears from MEISSNER's account (*Prodr., loc. cit.*, 507) that PHILIPPI had suspected its existence in the seeds of *Gomortega*, but the author of the *Prodromus* rejected the fact. "*Sic dictum albumen procul dubio e cotyledonibus 2 arcte sibi invicem adplicatis constat.*" The *Prodromus* is also wrong in considering PERSOON inexact in describing the fruit as provided with a stone with two or three cells. There are always one or two abortive sterile cells, though it may not be always easy to see them. Hence the genus has no relation with *Cryptocarya*, whose fruit is normally one-celled and one-seeded.

[2] H. BN., *Adansonia*, ix. 118.—*G. nitida* R. & PAV., *loc. cit.*—*Lucuma Keale* MOL., *loc. cit.*—*Adenostemon nitidum* PERS., *loc. cit.* (nec BERTER.). It is the *Keale, Queule*, or *Hualhual* of the Chilians.

[3] The pedicel, which is axillary to a caducous bract, usually becomes reflexed before the expansion of the flower. Later it is much thickened, and becomes erect and rigid. All its parts are covered with brownish down. The leaves and bracts are sprinkled with numerous glandular dots.

relationship as do the *Pomaceæ* to those *Rosaceæ* in which the carpels always remain free from the receptacle.

The order *Monimiaceæ* was established in 1809 by A. L. DE JUSSIEU,[1] who included in it the genus *Tambourissa* of SONNERAT, which he called *Ambora*, and the genera *Monimia*, *Siparuna*, *Boldea*, *Mollinedia*, *Atherosperma*, and *Laurelia*. The two last genera were distinguished as possessing dry pericarps, while the rest have drupaceous fruits. *Tambourissa* dates as a well-defined genus from 1782; but FLACOURT had described it imperfectly as early as 1661.[2] A. L. DE JUSSIEU had in his *Genera Plantarum*[3] placed it among *Urticeæ* with the genus *Hedycarya*,[4] observed in 1776 by J. & G. FORSTER. *Siparuna* included American plants named by AUBLET in 1774, and studied under the name *Citrosma*, by RUIZ & PAVON in 1794. These authors made known at the same epoch the genera *Mollinedia*, *Pavonia* (*Laurelia*), and *Boldea* (*Ruizia*), which is the *Peumus* of MOLINA (1782). In 1806 LABILLARDIÈRE discovered *Atherosperma* in Australia, now-a-days considered a congener of *Laurelia*. In the same year DU PETIT-THOUARS had observed *Monimia* in the Southern Islands of Eastern Africa, and had thoroughly described this genus, which gives its name to the order.

Despite R. BROWN's[5] attempt to divide the *Monimiaceæ* into two perfectly distinct groups, of which the one with its fleshy fruits would retain its relations with the *Urticaceæ*, while the other, completely differentiated by its dry fruits and valvular anthers, would come near *Lauraceæ*, most recent authors, especially ENDLICHER, A. RICHARD, and L. R. TULASNE have maintained in its integrity the natural group established by A. L. DE JUSSIEU. To this ENDLICHER, in 1836, added the genera *Doryphora* and *Kibara*, the latter of which we include in *Mollinedia*. The other types that in our eyes should also form part of this genus are of more recent creation. *Matthæa* was proposed by BLUME, in 1856; *Wilkiea* by MUELLER, and *Ephippiandra* by DECAISNE in 1858. The last author also ascribes the

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1 *Mémoire sur les Monimiées*, *Ann. du Mus.*, xiv. 116.

2 *Histoire de la Grande Ile de Madagascar*, 133, n. 69.

3 401, n. 1706.

4 *Loc. cit.*, n. 1708.

5 *Gen. Rem. Geogr. and Syst. on the Bot. of Terra Australis* (1814), 21; *Misc. Works*, ed. BENN., i. 25.

genus *Ægotoxicon* of RUIZ & PAVON[1] to the *Monimiaceæ*, but his opinion has not yet been adopted by the authors who have recently traced out the limits of this order.[2]

In 1864 F. MUELLER established the genus *Palmeria* for an Australian Monimiad, very close indeed to *Monimia*. The genus *Hortonia* was created by WIGHT, in 1838;[3] but, originally placed near the *Schizandreæ* and *Anonaceæ*,[4] it was only eventually included in *Monimiaceæ*.[5] It was also quite recently[6] that we restored to it the genera *Calycanthus* of LINNÆUS, and *Chimonanthus* of LINDLEY (1819); whose kinship to *Monimiaceæ* and *Atherospermeæ*, recognised for a short period,[7] was even lately contested, and finally rejected.[8] At the same time we proposed[9] that the genus *Gomortega* of MOLINA (1782), hitherto referred to *Lauraceæ*, should be considered as the type of a new tribe of the order under consideration.

We divide the order *Monimiaceæ* thus constituted into five secondary groups or series: 1, *Calycantheæ*; 2, *Hortonieæ*; 3, *Tambourisseæ*; 4, *Atherospermeæ*; 5, *Gomortegeæ*. By recalling the principal features of each of these, and pointing out their differences, we shall show what characters of importance are variable in this natural group.

I. In all *Monimiaceæ* of the last four sections, the embryo is small, and surrounded with copious albumen, and the floral receptacle bears few appendages, or none, below its superior orifice. In the CALYCANTHEÆ, on the contrary, these appendages are numerous, and evidently arranged in a spiral. The embryo nearly fills the whole cavity of the seed, and its broad cotyledons are rolled on each other, while the albumen is absent, or only represented by a little central spit of cellular tissue.

II. The HORTONIEÆ have drupaceous fruits, free alike from each other and from the receptacle above which they spread freely, through the enlargement of its apex, through its tearing irregularly to free them, or through the upper part coming off like a lid in one circular piece, below the insertion of the perianth and androceum.

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1. *Ann. Sc. Nat.*, sér. 4, ix. 279; *Bull. Soc. Bot. de Fr.*, v. 214.
2. See A. DC., *Prodr.*, xvi. s. post., 641.
3. ARN., *Mag. of Zool. and Bot.*, ii. 546.
4. ENDL., *Gen.*, *Suppl.* ii. 107.
5. HOOK. F. & THOMS., *Fl. Ind.*, i. (1855), 166.
6. *Adansonia*, ix. (1868), 112.
7. See JUSS., *loc. cit.*—LINDL., *op. cit.*, n. 404.—A. GRAY, *Gen. Ill.*, i. 56.
8. B. H., *Gen.*, 16.
9. *Op. cit.*, 113, 118, 126.

III. The fruits are also drupaceous in the TAMBOURISSEÆ; but the common receptacle instead of freeing them, becomes hypertrophied, and rises around them and in their intervals so as to enframe each in a sort of complete chamber, surrounding the whole in a common mass partitioned off into as many compartments as there are drupes.

IV. In the ATHEROSPERMEÆ, on the contrary, the carpels finally become free, as in the *Hortonieæ*, but the pericarp is dry, and each fruit is an achene or caryopsis, covered with numerous accrescent hairs to promote dissemination.

V. Finally, the GOMORTEGEÆ have their carpels in contact, and forming a thick stone with several cells, which is closely united with the receptacle, and finally becomes with it a single drupe, crowned with the scar of the perianth.

The characters that we have not employed to distinguish these five series may be ranged in three categories.

1. Some are constant, and hence cannot serve to subdivide this group, but only to separate it from certain other orders more or less closely allied. These are as follows: The concavity of the floral receptacle, and its direct consequence in the perigyny of the perianth and androceum; the imbrication of the pieces of the perianth and androceum; the primitive existence of two cells in the anthers; the complete or nearly complete anatropy of the ovules; the direction of the micropyle, which is always introrse when the ovule is descending, or what amounts to the same thing, extrorse when it is ascending; the absence of stipules; and finally, the consistency of the stem, all known *Monimiaceæ* being trees or shrubs, never herbaceous plants.

2. Other characters are nearly constant; we only find very rare exceptions, usually occurring in tribes or genera, all the other features of which are found in those species in which one of these nearly absolute characters is wanting. Such exceptions are—the alternation of the leaves, found in a single *Tambourissa*[1] and two other species of the order which are still doubtful or little known;[2]

[1] See p. 305, note 2.

[2] The one has been noticed by ASA GRAY as probably belonging to *Atherospermeæ* (*Journ. of Bot.*, iv. 83). The other is a plant from New-Caledonia, whose male flowers alone are known as yet, and which we provisionally name *Amborella trichopoda*. Each flower is borne on a long pedicel, and may be described as a very small flower of *Hedycarya*, with a concave receptacle bearing on its edges a variable number (6–15) of unequal imbricate leaves, and in its concavity an equally variable number (8–12) of stamens, like those of *Hedycarya*, each consisting of a sessile erect introrse anther, dehiscing by two longitudinal clefts. These flowers are solitary or fascicled on the wood of the branches or in the axils of the leaves, which are irregularly elliptical or oval, and coarsely crenulate.

the presence of an abortive ovule beside the sterile one; a character almost constant, it is true, in *Calycanthus*, but not invariably found in *Hortonia*, and never observed in any of the other genera of *Hortonieæ*.

3. Last of all come those characters which very frequently vary, their absence and presence being about equally frequent; so that none are sufficient to do more than distinguish different genera, or different sections of a single genus. These are—the presence of glandular dots, and the resulting aroma; the conformation of the hairs covering certain organs, especially the leaves;[1] the dehiscence of the anthers in straight or curved lines, or by valves; their aspect; the presence or absence of glands at the base of the filaments; the way the floral receptacle opens to free the pollen in the male flowers or the carpels in the fruit, whether by longitudinal clefts, by a transverse circular solution of continuity, or by the simple dilatation of its superior orifice; the consistency of the different parts of the fruit—the indusium and the true pericarps;[2] and finally, the absolute direction of the ovules and seeds, whether ascending or descending.[3]

From a histological point of view, the vegetative organs in this order are always very uniform.[4] The stems and branches are cylindrical or slightly quadrangular. In the aromatic species the bark is always the part that is richest in odoriferous matter, and is very often the only portion that contains any. Usually, as in *Peumus*, *Hortonia*, certain species of *Mollinedia*, and the *Atherospermeæ*, the

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[1] See p. 300, note 2, and p. 322.

[2] Following A. L. De Jussieu, Tulasne has based two of his tribes on this character; *Atherospermeæ* (*Achænophoreæ*) with dry fruits, and *Monimiaceæ* (*Drupaceæ*) with the pericarps partly fleshy. We have shown (*Adansonia*, ix. 125) that there are numerous transitions between the drupes and the achenes; that the *Calycantheæ* originally possess drupes with thin pericarps, that the fruits of *Siparuna* are, so to speak, half-drupes, and that certain *Atherospermeæ* have rather caryopsids than achenes. Besides Tulasne has clearly perceived (*Mon.*, 425) that *Hortonia* affords a transition between the true *Monimiaceæ* and the *Atherospermeæ* in the characters of its fruits.

[3] A. De Candolle (*op. cit.*, 641) has used this character to distinguish the five tribes he admits in this order. His *Tambourisseæ*, *Monimieæ* and *Hedycaryea* would only include genera with pendulous ovules, while the plants of his *Atherospermeæ* and *Siparuneæ* would have erect ovules. But this last tribe is evidently heterogeneous, including *Siparuna*, whose ovule is ascending, and *Palmeria*, in which it is descending. We have said (*Adansonia*, ix. 130) that *Palmeria* is hardly generically distinct from *Monimia*. Le Maout & Decaisne (*Traité Gén. de Bot.*, 517) have asserted that the absolute direction of the ovule brings about a peculiar insertion for the style. "Ovule . . . sometimes pendulous, and then style terminal; sometimes erect, and then style lateral or basilar." The facts are contrary to this law; out of three genera, with erect ovules, two have the style not lateral, but thoroughly terminal, viz., *Siparuna* and *Atherosperma* (including *Laurelia*).

[4] Tul., *Mon.*, 282, iv.—Oliv., *the Struct. of the Stem in Dicot.*, 30.

aroma is due to an oleo-ethereal substance contained in the cortical parenchyma. Its colour, varying from yellow to reddish-brown, indicates its presence in certain cells, which are sometimes as thin-walled as the surrounding cells, sometimes thickened like the sclerous cells of the *Wintereæ*, and riddled with large perforations. The wood of the *Monimiaceæ* is generally soft,[1] and is always remarkable for the number, size, and distinctness of the equidistant medullary rays. These all consist of nearly equal cells, which have always appeared to us full of starch and finely punctate. The woody bundles present no very peculiar character. Like some of the vessels, the fibres are pitted, and the perforations are either circular, elliptical, or even nearly linear and transverse (*Peumus*). Very often, too, their openings are surrounded by an areola of the same form as themselves, but this is narrow, and not nearly so well defined as in most *Magnoliaceæ*. These pores are, then, intermediate between the areolate pores observed in certain orders and the common perforations of fibres or vessels. They are found in great numbers in certain vessels of *Peumus* and *Hortonia*, covering the whole of the walls so that we can find no trace of arrangement into distinct vertical rows In the same plant we may find some pores rounded or oval, others like more or less elongated slits. This fact was observed by TULASNE, who has seen the walls of certain vessels partly destroyed and cut up into scalariform or cancellate plates. According to the same observer, the woody fibres are narrow and elongated, and the medullary sheath, as usual, contains spiral vessels. But these have often appeared to us very scanty. The axes of the *Calycantheæ* alone present one very remarkable peculiarity observed for the first time by B. DE MIRBEL,[2] in 1828,

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[1] We should except certain woods employed in building, especially the *Atherospermeæ* (see p. 327).

[2] *Note sur l'Organisation de la Tige d'un très-vieux* Calycanthus floridus *du Potager royal de Versailles, Ann. Sc. Nat.*, sér. 1, xiv. 367, t. xiii. "The four bundles each present a proper cortical envelope, woody layers, one above another, large vessels forming zones in the wood, rays prolonged from the centre to the circumference, and a medullary canal." This fact has been reproduced, re-observed, or commented on by very many authors. LINK (FROR., *Neue Notiz.*, xxxiv.; *Flora* (1845), 558), has studied the composition of these cortical bundles. METTENIUS (*Ein. Beob. üb. d. Bau der Bignon.*, *Linnæa* (1847), 580) has seen them appear in the young branches, as four isolated liber bundles in the cortical cellular tissue. On the side towards the axis of the branch arise spiral vessels, within which are developed woody fibres and dotted vessels. At the age of five years the liber bundles are still unaltered, while the wood has doubled in thickness.—See also TREVIRANUS, *Phys. d. Gewächs.* (1835), i. t. i. 10.—HENFREY, *Ann. of Nat. Hist.*, ser. 2, i. 125. — LINDL., *Introd. to Bot.*, i. 209; *Veg. Kingd.*, 541.—HARTIG, *Bot. Zeit.* (1859), 109.—OLIVER, *op. cit.*, 13.

consisting in the presence of four cortical fibro-vascular bundles, corresponding with the angles of the stem. These accessory bundles are related to the decussate leaves which spring from the branches.[1]

The epidermic layer is also the seat of a certain number of interesting modifications. Both on the axes and on the appendages, it often bears ridges, wrinkles, hairs, or scales. Very few of the *Monimiaceæ* are completely glabrous. Even *Hedycarya arborea*, in which the surface appears very smooth, has some simple hairs on the young branches and the veins of the leaves. In the *Calycantheæ* these hairs are quite characteristic. Their bases consist of rough prominent epidermic cells.[2] The hairs themselves, conical and bent like a bird's claw, lie on the surface of the leaf with their points towards its apex; so that the leaf only feels rough when the finger is passed towards the base. On the leaves of *Peumus Boldus* are similar hairs, but they are thinner and less rigid; some are simple, while others are stipitate, affording a transition towards the stellate hairs of *Monimia*,[3] *Palmeria*, and certain species of *Siparuna*. In these three genera the hairs may consist of a large number of equal diverging branches; or its upper part may simulate a simple hair, through the enormous development of the terminal branch, while the lateral branches are very short in proportion, only forming a slight swelling near its base. Several species of *Siparuna* possess only sessile stellate hairs; in others, again, the part of the leaf bearing the hair forms a conical elevation, so that the hair radiates from the apex of a more or less rigid prickle. Finally, several *Siparunas*, especially *S. Conuleum*, are covered with peltate, radiated, scaly hairs, altogether like those of the *Elæagnaceæ*.

Affinities.—The *Monimiaceæ* were formerly put near the *Urticaceæ*, especially the *Artocarpeæ*, by those botanists only who confounded the floral receptacle of *Siparuna*, *Tambourissa*, and other allied genera, with the similarly formed receptacle bearing the

[1] Trevir., *Ueb. ein. Arten anomal. Holzbild. bei Dicotyl.*, *Bot. Zeit.* (1847), 379.—Gaudich., in Guillem. *Arch. Bot.*, ii. 493. This relation is also demonstrated by the fact that in those abnormal branches where the leaves become alternate, and are arranged in a spiral, whose angular divergence is $\frac{2}{5}$, there are five of these accessory bundles in the bark. (See *Adansonia*, ix. 106.)

[2] On the superior surface of the leaf (see p. 286, note 4) these hairs are far more developed in *Chimonanthus* than in *Calycanthus*.

[3] Tulasne (*Mon.*, 275) admits the existence of these stony concretions, called by Weddell cystoliths, in the leaves of *Monimia* and *Peumus*.

whole inflorescence in the Fig. Thus these authors wrongly considered the stamens or carpels, which we have described as parts of a single flower, as so many male or female flowers; and in this respect it has been with *Monimiaceæ* as with *Euphorbia*.[1] If, on the contrary, we look on the different carpels collected on one and the same receptacle as the elements of a single gynæceum, the *Monimiaceæ* become comparable to the *Polycarpicæ*; and it is among these last that we must look for their analogues, especially among those in which the stamens are perigynous on a concave floral receptacle, which forms a common envelope or indusium to a multiple fruit. This is especially the case with the *Roseæ*;[2] which however in the verticillate arrangement of their stamens differ sensibly from the *Monimiaceæ*; while the stamens are frequently inserted in a spiral in the *Polycarpicæ* with a convex receptacle, such as *Magnoliaceæ*, *Anonaceæ*, &c. Hence it is, no doubt, that several contemporary writers[3] have placed *Monimiaceæ* near these natural groups; while the existence of valvate stamens in both *Monimiaceæ* and *Lauraceæ* has indicated a relationship between the two groups, the reality of which we shall soon try to demonstrate.

According to what we have just said concerning the spiral arrangement of the stamens of the most highly organized *Monimiaceæ*, if there were among the *Polycarpicæ* a genus with a concave receptacle and non-verticillate perigynous stamens, it would serve as a transition between the *Monimiaceæ* on the one hand, and the *Magnoliaceæ* and *Anonaceæ* on the other. We find two types that do this: the *Eupomatieæ*[4] and the *Calycantheæ*. *Eupomatia*, a true Anonad in its ruminated albumen and in its vegetative organs, has the concave receptacle of the *Monimiaceæ*, and the fruit organized like that of the *Siparuneæ* and *Tambourisseæ*, the true carpels being imbedded in a common indusium formed by the persistent and thickened floral receptacle; and though *Eupomatia* has not the opposite leaves of the *Monimiaceæ*, a character formerly held of capital importance, yet it is now known that there are some *Tambourissas* with alternate leaves,[5] and in this respect altogether like the two known species of

[1] See *Adansonia*, ix. 116.

[2] Ad. Br., *Enum.*, ed. 2, 43.—A. Juss., *Dict.* d'Orbigny, xii. 419, 422.—Endl., *Enchir.*, 658.—Lindl., *Veg. Kingd.*, 299, 300, 540.—Tul., *Mon.*, 285, 287.

[3] Hook. F. & Thoms., *Fl. Ind.*, i. 163.—B. H., *Gen.* 15.

[4] See pp. 242, 261.—H. Bn., *Adansonia*, ix. 25.

[5] See p. 305, note 2, and p. 319.

Eupomatia. Nobody now ignores the close relation between *Magnoliaceæ* and *Calycantheæ*, so that we may call the latter *Magnoliaceæ* with a concave receptacle and perigynous stamens; and if we supposed the organic apex of the receptacular pouch of a *Calycanthus* drawn up till it was above the level of the insertion of the stamens, we should have nearly the flower of one of the *Magnolieæ* or *Illicieæ*, according as the receptacle projected much or little above the stamens. However, most contemporary authors have after all rejected the apposition of the two types, thinking that they saw a difference in the morphological signification of the floral sac of the *Calycantheæ* and of the *Monimiaceæ*, considering that of the former as an axis, that of the latter as the basilar part of a calyx, *i.e.*, of the union of several appendicular organs. Now, we have shown[1] that this sac is of axial nature in the *Monimiaceæ* as well as in the *Calycantheæ*, for in both groups it bears the same appendicular organs, and there are several genera of *Monimiaceæ* in which it normally gives insertion to bracts identical with those remarked in greater numbers on its outer surface in the flowers of the *Calycantheæ*. The only real difference between the two groups lies in the internal structure of the seed; and there are many natural orders where the same difference is presented, without its enabling us to found any larger divisions than tribes, and even these are not always well defined.

We now return to the *Lauraceæ* through *Gomortega* (*Adenostemon*), whose vegetative organs are those of a Monimiad, but whose flower and fruit, until very recently insufficiently studied, have misled botanists as to its true affinities.[2] With the seed and androceum of many *Monimiaceæ*, *Gomortega* has a pluricarpellary gynæceum not found in the true *Lauraceæ*. But the different carpels cohere within the receptacular sac into a single fruit with a plurilocular stone. In the dialycarpous *Rosaceæ* we find the same thing in the secondary group of the *Pyreæ*, but yet no one dreams of separating them from the rest of the order. Not that we would imply that there are not very close affinities between *Gomortega* and the *Lauraceæ*. On the contrary, they are demonstrated by what we have just established; and, as we have said elsewhere,[3] "In as natural a classification as our

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[1] *Adansonia*, ix. 115. [2] See p. 315, and p. 316, note 1. [3] *Adansonia*, ix. 120.

present information would allow, after *Monimiaceæ*, we should have to describe *Lauraceæ* as types with a less marked, but still incontestible, perigynous insertion, and a unicarpellary gynæceum, corresponding with the *Pruneæ* among *Rosaceæ*. When a Laurad with opposite aromatic leaves, valvicidal stamens, and a receptacular sac surrounding the fruit completely, is observed at the season of the maturity of the seed, the only difference that would appear between it and a Monimiad in which only one carpel should become fertile is in the structure of this seed; it has no albumen. And even this character is not absolute, if, with several authors, we include the group *Adenostemeæ* in the order *Lauraceæ*. The natural series which may some day be drawn up, when further study shall have overthrown the barriers raised by habit between *Polypetalæ* and *Apetalæ*, will be one whose highest type is found in *Calycanthus* and the hermaphrodite *Atherospermeæ*, and will pass through the other *Monimiaceæ* to finish in the most lowly-organized *Lauraceæ* with unisexual flowers."

The *Monimiaceæ* are distributed over a not very wide zone[1] from N. to S., extending about 50° on each side of the equator; but the true *Monimiaceæ* stop short towards about 25° N.; the zone from 30° to 50° being occupied by the *Calycantheæ* only, *Calycanthus* in America, *Chimonanthus* in Asia. Out of thirteen known genera, eight as yet belong exclusively to the northern hemisphere, and three to the southern. The two others, *Mollinedia* and *Siparuna*, are common to both; but they have not been found at a greater distance than about 20° from the equator. In species the New World is far richer than the Old, for out of one hundred and forty-two known distinct species of *Monimiaceæ*, one hundred belong to America, especially to Chili, Peru, Columbia, Guiana, and Brazil. North America and the West Indies possess but half a score species. The two genera *Mollinedia* and *Atherosperma*, as limited by us, we have already stated to occur in both Worlds. The New World alone produces the four genera *Siparuna*, *Peumus*, *Gomortega*, and *Calycanthus*; while the seven genera *Tambourissa*, *Monimia*, *Palmeria*, *Hortonia*, *Hedycarya*, *Doryphora*, and *Chimonanthus* are as yet confined to the Old. None is

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[1] Tul., *Mon.*, 290, vi.—Endl., *Gen.*, 313; *Enchir.*, 196.—Lindl., *Veg. Kingd.*, 299, 300.

European, and two of the Asiatic genera have a very limited range, *Chimonanthus* being only found native in Japan, and *Hortonia* only in Ceylon. Oceania, including Australia and the Sunda islands, possesses six genera, three of which are proper to it, viz., *Hedycarya*, *Palmeria*, and *Doryphora*. *Atherosperma*, *Tambourissa*, and *Mollinedia* are common to it and other parts of the globe. However, only one *Tambourissa* is known in Java; all the rest belong to the Mascarene Islands and the Madagascar Archipelago, the habitat of *Monimia* also. America, too, possesses genera with very restricted ranges, especially *Peumus* and *Gomortega*, which only occur in Chili. *Calycanthus* is exclusively North American. Probably most of the *Monimiaceæ* that still remain to be discovered will be found in Polynesia; already three or four species have been found in New Caledonia.[1]

The uses of the *Monimiaceæ*[2] are not very numerous. Several species are remarkable for their aromatic odour, and are in this respect quite analogous to the *Lauraceæ*, to which they come so near in organization. This perfume, due to a volatile essential oil, is found especially in the leaves and bark of the *Atherospermeæ*.[2] *Atherosperma Moschata* LABILL. is used as tea by certain Australian colonists.[3] Its bark, fresh or dried, is used to prepare a pleasant-tasted, slightly aperient stimulating decoction, drunk with milk. *Doryphora Sassafras* ENDL. is also very odoriferous; its wood is said to smell of fennel, and has been used as a carminative in Australia. *A.* (*Laurelia*) *sempervirens* is aromatic and stimulant. Its bark is commonly employed in Chili for cooking, and its fruit smells something like the nutmeg, and is used instead of it.[4] The *Boldu* (*Peumus Boldus* MOL.) is the species best known in America as an aromatic plant.[5] The perfume of the leaves recalls certain *Labiatæ*, *Myrtaceæ*, and *Lauraceæ*. From them is prepared an infusion which helps digestion, and is prescribed as a tonic, carminative, and diaphoretic, while their decoction in wine cures headache

[1] See *Adansonia*, ix. 128, 132. Several fossil *Monimiaceæ* have also been described (see UNGER, in SEEM. *Journ. of Bot.* (1865), 64.

[2] ENDL., *Enchir.*, 196, 657.—LINDL., *Veg. Kingd.*, 299, 300, 511.—TUL., *Mon.*, 290.—ROSENTH., *Syn. pl. diaphor.*, 227, 232, 951, 1111.

[3] BACKH., ex LINDL., *op. cit.*, 300.—TUL., *Mon.*, 291.—HOOK. F., *Fl. N.-Zeal.*, i. 218.—H. BN., *Dict. Encycl. des Sc. Médic.*, vii. 79.

[4] H. BN., *Dict. Encycl. des Sc. Méd.*, sér. 2, i. 25.

[5] FEUILL., *Hist. Pl. Med. Peruv. et Chil.*, 11.—R. & PAV., *Syst. Veg. Fl. Per. et Chil.*, i. 254, 268, 269.—BERTERO, *Merc. Chil.* (1829), 685.

and stomach ache. They are preferred by the Chilians to bay-leaves for seasoning dishes; they are also powdered and used as snuff. The fruit is edible, and the perfumed mesocarp is highly prized by the natives. They also eat the fruit of the *Keale* (*Adenostemum nitidum* PERS.). Several species of *Siparuna* are also aromatic, but are little used. *S. guianensis*, under the name of *Vulneraire* [*Vulnerary*] is used to prepare an infusion sometimes prescribed at Cayenne.[1] *S. brasiliensis* and *alternifolia* from Brazil,[2] *S. dentata* and *piricarpa* from Peru, and *S. petiolaris* from New Granada, are cited as aromatic species. The name *S. Thea*[3] indicates the properties of a species found in the Brazilian province of St. Catherine.

The flowers of the *Calycantheæ* have well marked perfumes, which in most species of *Calycanthus* recall those of certain fruits, such as the apple, pineapple, melon, &c. The bark is also very aromatic. That of *C. floridus* L. (*Carolina Allspice*), is substituted for cinnamon in medicine as a tonic, stimulant, aperient, and stomachic. The bark of the root smells of camphor. This aroma we do not find in the flowers and leaves of *Chimonanthus præcox*,[4] where it is replaced by a quite peculiar pungent acrid taste. The sweet scent of its expanded flowers in winter is well known.

The wood of several *Monimiaceæ* is also perfumed, and is therefore prized for building dwelling-houses; especially in Chili do they use the brownish wood of the *Boldu*, and the yellow or greenish-white wood of *Atherosperma sempervirens*. *A. Novæ-Zelandiæ* and *moschata* serve the same purposes in their native countries. The trunk of the latter attains an enormous size. It is a fine tree, upwards of 160 feet in height and 6 feet in diameter, branching like a Pine, and of splendid appearance. Its wood is employed in ship-building. That of the inodorous *Monimiaceæ* is only used by the cabinet-maker and for framing. *Tambourissa quadrifida* is the *Bois Tambour* or *Tamboul* of the Mascarene Islands. *T. vestita* is the *Bois Gilet* of Bourbon. *T. religiosa* is used in Madagascar for making coffins, which are said to preserve the body from putrefaction. It appears that several species of this genus produce an odoriferous gum, or gum resin. The fruits of *T. quadrifida* and others bear the vulgar

[1] AUBL., *Guian.*, ii. 865, t. 333.

[2] MART., *Fl. Brasil., Monimiac.*, 325.

[3] SEEM., *Journ. of Bot.*, ii. (1864), 343.

[4] KÆMPFER, *Amœn. Exot.*, 878, t. 879. The Japanese call this tree *Obai* or *Robai*.

names of *Pomme Jacot*, *Pot-de-chambre Jacot*, and *Pomme de singe*. The fleshy red mesocarp of their drupes is eaten by birds, and its juice might serve as a dye, like arnotto.[1] In Europe, we often receive from Madagascar and the Mascarene Islands rods of so-called *touchwood* (Fr., *bois à allumer*) from which we can in fact obtain fire by rubbing them briskly together. The wood, of very little solidity, traversed by very regular medullary rays, and the large spongy pith, would seem to indicate that, despite the doubts that have been expressed, this touchwood is really that of a *Tambourissa*.

[1] FLAC., *Hist. de la Grande Ile de Madagascar*, 133.

GENERA.

I. CALYCANTHEÆ.

1. **Calycanthus** L.—Flowers hermaphrodite regular; receptacle thick urceolate; perianth-leaves ∞, inserted in a spiral on outer face and throat of receptacle; outer leaves lowest, short bract-like distant; superior sepaloid; inner leaves finally larger coloured petaloid; æstivation imbricate. Stamens ∞, inserted in a spiral within the throat; outermost (10–15) fertile; filaments free; anthers basifixed apiculate 2-celled extrorse dehiscing longitudinally; inner sterile short. Carpels ∞, free inserted within receptacular cavity; ovary 1-celled, tapering into a slender style stigmatiferous at apex; ovules 2, inserted at base of ventral angle, finally superposed ascending; micropyle extrorse inferior; raphe ventral; one ovule finally abortive. Achenes (often subdrupaceous) ∞, included in herbaceous-subcarnose receptacle marked externally and at apex with scars of fallen bracts; throat surrounded by thickened filaments of stamens; apex finally open. Seeds solitary erect, each surrounded by its pericarp; embryo straight, cotyledons broad leafy convolute; albumen 0, or scanty central.—Aromatic shrubs; leaves opposite exstipulate; flower either axillary and solitary or in small cymes, or terminal (*North America*). See p. 281.

2. **Chimonanthus** Lindl.—Flowers of *Calycanthus;* receptacle less concave; perianth-leaves ∞; innermost smaller, intermediate larger, dissimilar in colour; outermost very short scarious or dry bract-like, imbricated in a spiral. Stamens fertile few (usually 5, 6); sterile internal, after anthesis growing thick, closing the throat of the receptacle. Gynæceum, fruit and seeds of *Calycanthus.*—A shrub; leaves caducous; flowers axillary appearing before the leaves. Peduncles short covered with ∞ decussate bracts similar to outer perianth-leaves (*Japan*). See p. 285.

II. HORTONIEÆ.

3. **Hortonia** Wight.—Flowers polygamous (of *Chimonanthus*); receptacle more or less deeply urceolate; perianth-leaves ∞, inserted

in a spiral on its mouth, imbricated; outer shorter sepaloid, inner larger petaloid accrescent. Stamens ∞, all abortive, or a few (4–10) exterior fertile; filaments short inserted on receptacle within perianth, with 2 lateral stipitate glands at base; anthers 2-celled extrorse dehiscing longitudinally. Carpels ∞, free inserted in bottom of receptacle, sterile or fertile; ovary 1-celled tapering into a linear style, stigmatiferous at apex; ovule 1, descending; micropyle superior introrse; raphe ventral: more rarely 2; the one minute abortive. Fruits ∞, drupaceous free surrounded at base by irregularly torn dry remains of receptacle and perianth; putamen hard 1-seeded. Seed pendulous; albumen copious fleshy oily; embryo minute inverted oblique; cotyledons slightly diverging; radicle superior.—Aromatic shrubs; leaves alternate exstipulate, with pellucid dots; flowers axillary cymose (*Ceylon*). See p. 287.

4. **Peumus** Mol.—Flowers diœcious (of *Hortonia*); receptacle subcampanulate; perianth-leaves ∞, imbricated; outer few (4–6) sepaloid; inner (5–8) petaloid elongated spreading. Stamens ∞, in male flower fertile; filaments free inserted inside concave receptacle, with 2 lateral flattish glands; anthers 2-celled introrse, dehiscing longitudinally. Carpels in male flower 0, or minute abortive; in female flower few (2–5), fertile inserted at bottom of receptacle, surrounded by ∞ perigynous staminodes; ovary 1-ovulate; ovule pendulous; micropyle superior introrse. Drupes 1–5, surrounded by persistent cupuliform internally setigerous base of receptacle; perianth deciduous after anthesis, circumcissile; mesocarp slightly fleshy; endocarp thick very hard. Seed of *Hortonia;* embryo inverted cotyledons widely diverging.—Small aromatic trees; leaves opposite warty pilose; flowers in terminal or axillary racemose cymes (*Chili*). See p. 290.

5. **Hedycarya** Forst.—Flowers diœcious; receptacle broad cupuliform or patelliform; perianth leaves ∞, more or less connate at base, either bract-like imbricated, or inconspicuous confounded in a short subentire or sinuate cupule. Stamens ∞ (in female flower 0); filaments very short or almost wanting erect; anthers 2-celled, dehiscing by introrse or lateral clefts; connective hardly projecting or apiculate above cells, or dilated and obliquely or transversely truncated at apex: more rarely subpetaloid. Carpels in male flower 0,

in female ∞, free sessile crowded on the torus; style of variable form; ovule 1 (of *Peumus*). Drupes ∞, free inserted on a slightly concave or convex receptacle, often stipitate. Seed pendulous (of *Hortonia*).—Small trees or shrubs evergreen; leaves opposite; flowers axillary cymose or racemose (*Australia, Oceania*). See p. 292.

6. **Mollinedia** R. & Pav.—Flowers monœcious or diœcious; receptacle of variable form, more or less concave; perigonium sacciform, externally naked or with a few bracts; apex more or less deeply lobed; lobes usually 4, 5, more rarely 6, imbricated, finally spreading; perigonium more rarely deeply 4-fid, split down the sinuses. Scales 0, or more rarely few (staminodes?) in throat of receptacle. Stamens 4–40, inserted in ∞ vertical rows inside receptacle from mouth to base, all fertile, or 1, 2 external scale-like; filaments very short or almost wanting, erect; anthers selliform; cells 2, linear lateral dehiscing longitudinally; lines of dehiscence finally confluent. Perigonium of female flower circumcissile, coming off close to base of sac. Carpels ∞, free, included, inserted on persistent finally cupuliform base of receptacle; ovary 1-celled; ovule 1 (of *Hedycarya*): style of variable form stigmatiferous towards apex caducous. Fruit of *Hedycarya*.—Trees or shrubs; leaves opposite or more rarely verticillate; flowers usually cymose; cymes terminal or axillary, 2–pluriparous or more rarely 1-parous, often few-flowered, very rarely 2–1-flowered (*Tropical and subtropical America, Australia, Indian Archipelago, Madagascar*). See p. 293.

7. **Monimia** Dup.-Th.—Flowers diœcious; receptacle of male sacciform ovoid, bearing on its contracted throat a very small 4–6-merous, finally 4–6-partite perianth. Stamens ∞, inserted within the sac; filaments free inflexed, finally erect, with 2 lateral stipitate glands at base; anthers basifixed dehiscing by 2 lateral introrse or extrorse clefts. Perigonium of female flower not cleft, finally becoming thick and fleshy around the fruit. Ovaries few (4–6), or ∞, free sessile in pilose bottom of receptacle; ovule 1 (of *Mollinedia*); style slender terminal, apex stigmatose exserted from narrow mouth of receptacle. Drupes ∞, 1-seeded, finally freed by tearing of receptacle. Seeds of *Mollinedia*.—Shrubs, covered with a usually stellate pubescence; leaves opposite; flowers axillary cymose (*Islands S.E. of Africa*). See p. 299.

8. **Palmeria** F. Muell.—Flowers diœcious. Perianth of male flower 4–8-merous, inserted on a pateriform receptacle; leaves inflexed imbricated. Stamens ∞, crowded on concave receptacle; filaments very short free erect; anthers elongated basifixed 2-celled introrse dehiscing longitudinally. Female flowers, fruits, and seeds of *Monimia.*—A climbing shrub; leaves opposite; flowers axillary cymose (*Australia*). See p. 300.

III. TAMBOURISSEÆ.

9. **Tambourissa** Sonner.—Flowers monœcious or diœcious. Male flower: receptacle fig-like, with a mouth at apex bearing a very small 4–6-merous perianth; finally usually cleft or partite from apex to base into 4–6 subequal or unequal lobes, staminiferous within. Stamens ∞, free; filaments short, finally erect; anthers basifixed with 2 lateral extrorse or more rarely subintrorse adnate cells dehiscing longitudinally. Female flower: receptacle a little thicker, mouth larger; perianth-leaves ∞, very short, scarcely conspicuous when adult. Carpels ∞, concealed in deep pits in receptacle; ovary produced at apex into style; stigmatiferous head projecting freely inside receptacle; ovule pendulous in each ovary; micropyle superior introrse; funicle elongated, dilated below into a conoidal obturator above micropyle. Drupes ∞, thickened, included in pits of open-mouthed receptacle, finally freed by its breaking or splitting unequally; mesocarp thin; putamen thin containing one pendulous seed; albumen fleshy, oily, copious; embryo subapical; radicle superior.—Trees or shrubs; leaves opposite, more rarely alternate. Flowers terminal or axillary, solitary or racemose, more rarely cymose (*Islands south-east of Africa, Java*). See p. 302.

10. **Siparuna** Aubl.—Flowers diœcious, or more rarely monœcious; receptacle of variable form, usually pyriform or obovoid, more or less constricted in the throat, bearing within this a conical velum of variable height, with a perforated apex, and outside it ∞ (usually 4–8) minute perianth-leaves. Stamens in female flower 0 (very rarely few, sterile, or in certain abnormal flowers fertile); in male flower few (3–6) or ∞, inserted at a variable height inside receptacle; filaments usually membranaceous, free or poly-, or more rarely monadelphous; anthers under apex of filament, introrse,

2-celled; cells dehiscing by valves from below upwards; valves 2, finally confluent into 1. Staminodes ∞ exterior or 0. Carpels ∞, more rarely few (1–5), each concealed in a separate cell in the receptacle; ovary free, inserted by more or less oblique and broad base on the receptacle, 1-celled, at apex sensibly tapering into a style exserted through canal in velum, tip stigmatiferous; ovule 1, subbasilar ascending; micropyle extrorse inferior; raphe ventral. Berries smooth or hairy, more rarely echinate, included in septate, finally nearly dry or baccate receptacle; mesocarp usually incomplete, at apex thick fleshy, at base thin membranous; putamen bony, smooth rugose or echinate. Seed erect, albumen copious; embryo straight, radicle inferior.—Aromatic trees or shrubs; leaves opposite, or more rarely verticillate, glandular, covered with a simple or stellate, more rarely scaly pubescence; flowers cymose; cymes solitary or geminate, usually axillary, either 2–pluriparous, or by abortion, 1-parous unsymmetrical, sometimes 1-sexual, more rarely 2-sexual, terminal flowers male (*Tropical and subtropical America*). See p. 305.

IV. ATHEROSPERMEÆ.

11 ?. **Doryphora** Endl.—Flowers polygamo-diœcious, receptacle infundibuliform; perianth-leaves 6–8, sub-2-seriate, imbricate; innermost petaloid. Stamens ∞, perigynous inserted within and below perianth; interior ∞, sterile; exterior few (4–10) fertile; filaments free, short, with 2 external glands at base; anthers basifixed 2-celled extrorse; cells dehiscing by uplifted valves; connective slightly prominent on each side above the cells, produced at apex into a very long subulate tail. Staminodes interior antherless. Carpels ∞, free inserted in bottom of receptacle, in male flowers sterile, in female fertile, ovary stipitate, 1-celled; style inserted at variable height on dorsal angle, stigmatiferous at tip; ovule 1 subbasilar erect, micropyle superior extrorse. Fruits ∞, dry (caryopsids) anatropous (or campylotropous) included in thickened woody receptacle, finally splitting irregularly longitudinally. Style more or less persistent basilar; pericarp thin, covered with elongated hairs, albumen copious fleshy; embryo straight or incurved, radicle inferior.—Aromatic trees; leaves opposite serrate or crenate; cymes axillary or terminal (*Australia*). See p. 309.

12. **Atherosperma** LABILL.—Flowers monœcious or diœcious; receptacle sacciform or lageniform, more or less concave, perianth-leaves ∞ (5–15), 2- or pluri-seriate, imbricate; innermost petaloid. Stamens ∞ free inserted on throat of receptacle, sterile linear in female flowers, fertile in male and hermaphrodite flowers, filaments with 2 lateral scales at base; anthers basifixed adnate 2-celled extrorse, dehiscing by 2 uplifted valves; connective truncate at apex. Carpels ∞, in male flowers sterile, ovary free, 1-celled, at apex prolonged into a linear style; ovule 1, sub-basilar anatropous, micropyle inferior extrorse. Achenes ∞, surmounted by persistent plumose styles, included in indurated broadened lageniform receptacle, marked by the scattered scars of fallen bracts either below the apex or from base to apex; perigonium finally dilated at apex or unequally 2–4-cleft from apex to base, pericarp thin more or less adherent to seed. Albumen copious oily; embryo minute straight; radicle inferior.—Aromatic trees; leaves opposite; flowers axillary solitary or cymose; bracts 2 opposite inserted below receptacle, first embracing flower, finally deciduous (*Chili, Australia, New Zealand, New Caledonia?*) See p. 310.

V. GOMORTEGEÆ.

13. **Gomortega** R. & PAV.—Flowers hermaphrodite; receptacle sacciform, naked externally; perianth-leaves 8–10, unequal imbricate deciduous. Stamens 8–10, inserted on throat of receptacle; all or part fertile; filaments free unequal, with 2 lateral stipitate glands at base; anthers basifixed 2-celled introrse, dehiscing by uplifted valves; connective more or less produced above the cells. Carpels 2, 3; disc thick, adnate to throat of receptacle above the ovaries; styles free erect, apex acute stigmatiferous. Ovules solitary descending in each ovary; micropyle introrse superior; raphe dorsal. Fruit drupaceous, of 2, 3 carpels adnate to the receptacle; mesocarp fleshy thin; putamen bony, very hard and thick, 2-, 3-celled; 1, 2 cells effete. Seed pendulous; integuments membranaceous; albumen copious fleshy oily; embryo nearly apical, radicle superior; cotyledons membranaceous inferior.—An aromatic tree; leaves opposite exstipulate; flowers racemose axillary or terminal (*Chili*). See p. 315.

VI. ROSACEÆ.

I. ROSE SERIES.

The Roses[1] (Fr., *Rosiers*—figs. 373–378) have regular hermaphrodite flowers. The floral peduncle is dilated at its summit, as in most *Moni-*

Rosa pimpinellifolia (*Burnet Rose*).

FIG. 373.
Flower.

miaceæ, into a hollow receptacle, swollen and globular, or more or less elongated, like a purse or gourd On the edges of the narrow opening[2] representing the organic base of the receptacle are inserted the perianth

[1] *Rosa* T., *Inst.*, 636, t. 408.—L. *Gen.*, n. 631.—ADANS., *Fam. des Pl.*, ii. 294.—J., *Gen.*, 335, 452.—LAMK., *Dict.*, vi. 275; Suppl., iv. 708; *Ill.*, t. 440.—DC., *Prodr.*, ii. 597.—SPACH, *Suit. à Buffon*, ii. 8.—ENDL., *Gen.*, n. 6357.—B. H., *Gen.*, 625, n. 60.

[2] Generally this is more dilated than the short neck just below, where the receptacle is most contracted. It is the receptacular pouch which, in many descriptions, very few of which are recent, is considered as the lower coherent part of the calyx. Its outer surface may be glabrous or covered with hairs, or even prickles; sometimes, by accident, it bears one or several bracts, which demonstrate its axial nature. This is also confirmed by the numerous examples of

and androceum; while towards the bottom, answering to the organic apex, are grouped the elements of the gynæceum. The calyx usually consists of five[1] more or less dissimilar leaves, quincuncially imbri-

Rosa pimpinellifolia.

FIG. 374.
Longitudinal section of flower.

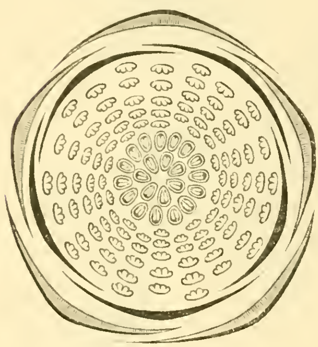

FIG. 375.
Diagram.

FIG. 376.
Carpel laid open.

cated in the bud.[2] The petals have short claws, and are as numerous as the sepals, alternating with them and similarly imbricated in the

monstrous roses, described and figured during the last two centuries, where the receptacle reverts more or less to the form of an ordinary branch, prolonged beyond the normal floral appendages to end in another flower, or producing lateral proliferous branches at different heights. The reader will understand that the nature of this work does not permit us to go fully into these matters of teratology, which are very interesting, and have served, since the time of GOETHE, to explain the morphological value of the axial or appendicular appendages entering into the formation of a flower.

[1] The number 5 is normal in *Rhodophora* (NECK., *Elem.*, n. 748;—ENDL., *loc. cit.*, b). We rarely find 4, and still more rarely 6; the former number characterizes the subgenus *Rhodopsis* (ENDL., *loc. cit.*, a).

[2] It is ascertained that the overlapped edges are simpler, more entire, and more membranous, and usually less green than those which overlap; these are usually fringed, incised, pinnatifid, or pinnatisect; and the more they are developed and lobed, the more they resemble the cauline leaves. In short, a sepal here represents a leaf especially developed in the lower portion (see PAYER, *Elém. de Bot.*, 151, fig. 264–269).

bud. The androceum consists of a large number of stamens inserted *in verticils*[1] round the circumference of a glandular disk which lines the interior of the receptacle,[2] and ends in a more or less thickened rim below the insertion of the perianth. Each stamen is composed of a slender free filament, inflexed or crumpled in the bud, and of an introrse, two-celled, more or less versatile anther, dehiscing longitudinally.[3] The carpels, indefinite and free, present a sessile or stipitate one-celled ovary, surmounted by a style which is continuous with its internal angle, and like it traversed by a longitudinal groove, while at the apex is a more or less dilated stigma. Sometimes the summits of these styles are separate; but they may, on the contrary, adhere together at a late stage, so as to simulate a single column. Inside the ovary, along its internal angle, is observed a parietal placenta, bearing towards its upper part a descending anatropous ovule, whose raphe is turned towards the placenta, while its micropyle looks upwards and outwards.[4] Beside this well-developed ovule, we sometimes find one aborted, which

[1] As regards arrangement, these are an indefinite number of "stamens of the *Rosaceæ*;" we always use this epithet as a phrase to denote briefly the *verticillate* arrangement of the androceum in this order, which we shall here demonstrate compendiously. The study of organogeny can alone show clearly the exact positions of the different stamens; and this has been done for the principal generic types by PAYER (*Traité d'Organ. Comp. de la Fleur*, 494–516, t. c.–ciii.). There are isostemonous *Rosaceæ*, possessing five stamens, superposed either to the sepals (*Sibbaldia*), or to the petals (*Chamærhodos*). Others have a diplostemonous androceum, in which one whorl is superposed to the sepals, the other to the petals (*Horkelia*, *Quillaja*, &c.). But the diplostemony may result from another cause, and ten stamens may be found in a single whorl in pairs superposed either to the sepals or to the petals (*Agrimonia*); so that this is due to a process of deduplication. Again, with five petals, we may have fifteen stamens, because five of the latter are superposed either to the sepals or petals, while the ten others are in pairs superposed to the petals or sepals; or twenty stamens, three in front of each sepal or petal, and one superposed to each petal or sepal (*Prunus*, *Pyrus*, &c.). Finally, when as in the present genus, we have a very large number of stamens, it is due to one of the two following causes: either there are originally few staminal whorls, and each stamen superposed to a sepal or petal, as the case may be, is replaced by a variable number of stamens; or, as occurs in the Roses, the alternating verticils (whether of five or ten stamens each) are indefinite in number, and extend from the orifice of the receptacle towards the bottom or organic apex. In *Rosa alpina*, PAYER has shown (*loc. cit.*) that the stamens arise as in *Geum*; first one verticil of ten, "grouped in pairs, one stamen on the right, and one on the left of each petal;" next arises another verticil of ten, alternating with the first, then a third, and so on.

[2] On the surface of the tissue of this disk are hairs (contact with which, as we shall see, produces a mechanical irritation of the skin) usually becoming more numerous as we approach the insertion of the ovaries, which also bear hairs of the same structure. They are simple and unicellular, ending in a long point, and contain at first a mixture of gas and liquid, and afterwards fine granulations of a greyish or slightly orange-yellow tint. At first the walls of these cells are thinner than the diameter of the cavity; but in the fruit they persist, and the walls become much thicker in proportion, and the hairs far more rigid.

[3] The pollen-grains are marked by three longitudinal folds, which become narrow bands in contact with water (H. MOHL, *Ann. Sc. Nat.*, sér. 2, iii. 340).

[4] It possesses only one coat, with an unequal, more or less oblique opening, sometimes irregularly festooned or laciniate (fig. 376).

originally resembled the former. The fruit (figs. 377, 378) is multiple, formed of a variable number of achenes, enveloped in a common sac or indusium, which represents the floral receptacle, now become fleshy throughout,[1] surmounted by the withered sepals or their cicatrices. Each achene is glabrous, or part of its surface is hairy.[2] Its walls are very hard and thick,[3] and surround a descending seed with membranous coats, containing a fleshy embryo with a superior radicle and elongated cotyledons, touching by their flat surfaces. There is no albumen.

Rosa canina (Dog Rose).

Fig. 377.
Fruit.

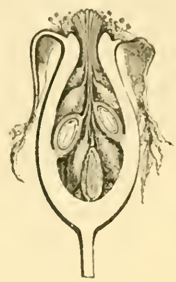

Fig. 378.
Long. section of fruit.

The Roses are shrubs, erect, branching, or creeping and climbing. Most of them are covered with prickles of suberous nature,[4] scattered over the stems, the petioles, the veins of the leaves, and the peduncles. Others are glabrous; others, again, are covered with glandular hairs. The leaves are alternate, imparipinnate, with the leaflets often serrate; and are provided with two broad membranous stipules, adnate to the petiole for a great part of their extent, and forming an incomplete sheath. In *R. berberifolia*,[5] of which it has been proposed to make a distinct genus under the name of *Hultemia*,[6] the leaves are reduced to a single leaflet, or perhaps rather to the base of the petiole, on each side of which the stipules are much developed.

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[1] The transformation into fleshy tissue may even extend to the peduncular portion of the floral axis; in certain forms of *R. alpina*, for instance, the summit of the peduncle is red and succulent, like the indusium. The outer surface of the latter often bears the hairs or prickles which already existed in the flower, and may now have increased in size. In the intervals between the achenes, too, the inner surface bears the hairs which we have already described on the disk (see p. 337, note 2).

[2] Especially on the two edges, more or less projecting towards the centre, and the walls of the receptacle, like those seen in *Calycanthus*. Should one alone of these edges have hairs, it is usually the one on the opposite side to the insertion of the style.

[3] The mesocarp, which is quite dried up when ripe, is in some species fleshy and pretty thick during nearly all the period of maturation. The fruit is then rather a drupe; we have made the same observation as regards *Calycantheæ*.

[4] They are formed by a hypertrophy of the corky layer, here forming a large number of projections with lenticular bases, the growth of which produces no rupture in the epidermis, so that this rises up over the whole of the prickle to cover it with a thin layer.

[5] Pall., *Nov. Act. Petrop.*, x. 379, t. 10, fig. 5.—DC., *Prodr.*, n. 25.—Red. & Thor., *Ros.*, i. 27.—*R. simplicifolia* Salisb., *Hort. Allert.*, 359 (ex Lindl., *Ros.*, 1); *Par. Lond.* t. 101.

[6] Dumort., *Note sur l'*Hulthemia.—Endl., *Gen.*, n. 6358.—*Lowea* Lindl., *Bot. Reg.*, t. 1261.—Spach, *Suit. à Buffon*, ii. 47.—*Rhodopsis* Ledeb., *Fl. Alt.*, ii. 224 (nec Endl.).

The Roses have usually very beautiful flowers, white, yellow, pink, or red, solitary or grouped in terminal cymes.[1] Numerous species of this genus have been described,[2] and their number is still daily increasing. While some writers enumerate three hundred, others will only admit one tenth of that number as distinct autonomous specific types. Most of them are cultivated in all countries, and their cultivation has produced numerous varieties, and numberless forms that are more or less monstrous. The wild species are found in all the temperate regions of the northern hemisphere, but are more numerous in the Old World than in the New.

II. AGRIMONY SERIES.

The Agrimonies[3] (Fr., *Aigremoines*—figs. 379–387) have regular hermaphrodite flowers, in general structure closely recalling those of the Roses, but with a great reduction in the number of most of the parts. Thus it often happens that on the borders of the sac which represents their floral receptacle[4] we only find three whorls of five pieces each, viz., five free valvate sepals,[5] five alternating imbri-

[1] One flower (the oldest) terminates the branch, and at variable distances below it are alternate leaves or bracts, axillary to which are flowers whose pedicels may again be similarly ramified. Usually the narrow cylindrical part of the pedicel is continuous with the dilatation which forms the floral receptacle. But in some Asiatic species, as *R. microphylla*, *bracteata*, *involucrata*, &c., these two parts are separated by an articulation, near which may be inserted bracts to form an involucre, or rather a calycle.

[2] MONARD., *de Rosa*, 1561. — ANDREWS, *Roses*, 1805-28.—THOR. & RED., *les Roses*, 1817-24.—DE PRONVILLE, *Mon. du. g. Rosier*, 1824.—TRATTIN., *Rosac. Monog.*, 1823, 24.—DESP., *Roset. Gallic.*, 1828.—LOISEL., *Ros.*, 1846. — LINDL., *Rosar. Monogr.*, 1820. — WALLR., *Ros. Gen. Hist. Succ.*, 1828 (see PRITZ., *Thesaur.*, 446).—DC., *Prodr.*, ii. 597–625 (146 esp.).—WIGHT, *Icon.*, t. 38, 324.—WALL., *Pl. As. Rar.*, t. 117.—BENTH., *Fl. Hongk.*, 106.—TORR. & GR., *Fl. N. Amer.*, i. 457.—A. GRAY, *Man. of Bot.*, ed. 5, 158 —CHAPM., *Fl. of S. Unit.-States*, 125.—GREN. & GODR., *Fl. de Fr.*, i. 551.—DESEGL., *Ess. sur* 105 *Esp. de Ros.*, 1865.—WALP., *Rep.*, ii. 11 ; v. 649 ; *Ann.*, i. 272, 971 ; ii. 465 ; iii. 854; iv. 654.—SERINGE has divided the genus into four sections. The grouping he published in the *Prodromus* has since been more or less modified (see MERT. & KOCH., RŒHL., *Deutsch. Fl.*, iii.—GESCHWIND, *Die Hybrid. und Sæml. d. Rosen*, 1863, 61.)

[3] *Agrimonia* T., *Inst.*, 301, t. 155.—L., *Gen.*, 607.—J., *Gen.*, 336.—GÆRTN., *Fruct.*, i. 317, t. 73.—LAMK., *Dict.*, i. 62 ; Suppl., i. 262 ; *Ill.*, t. 409.—SPACH, *Suit. à Buffon*, i. 482.—DC., *Prodr.*, ii. 587.—ENDL., *Gen.*, n. 6368.—PAYER, *Organog.*, 504, t. ci.—B. H., *Gen.*, 622, n. 53.

[4] Its throat is contracted, as in most of the Roses. Indeed, the two genera are as near together as possible in the general organization of their flowers.

[5] Some authors have considered as the pieces of a calycle five prickles, tolerably like those covering the superior portion of the receptacle, but broader and more bract-like at the base, which usually alternate pretty regularly with the pieces of the calyx. The sepals may after anthesis become imbricated and closely connivent; they even persist around the ripe fruit (figs. 383, 384).

cated petals,[1] and as many stamens superposed to the sepals. But often, too, we may find a larger number of stamens, *i.e.*, from five

Agrimonia Eupatoria.

FIG. 381.
Flower.

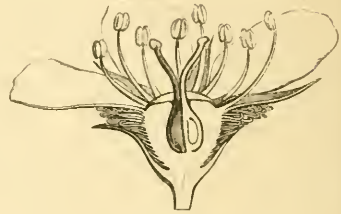

FIG. 382.
Longitudinal section of flower.

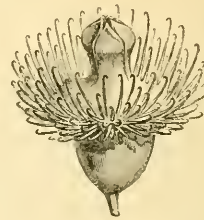

FIG. 383.
Fruit.

FIG. 380.
Inflorescence.

FIG. 379.
Habit.

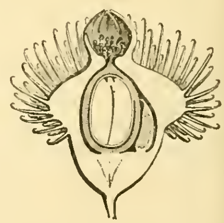

FIG. 384.
Longitudinal section of fruit.

to fifteen.[2] If there be the last named number, each of the stamens superposed to the sepals is accompanied by two others, one on either

[1] Their form is that of the petals of a Rose on a small scale.

[2] PAYER (*op. cit.* 505) has seen that in *A. Eupatoria* the number of stamens varies with the vigour of the plant. "Generally," says he, "we hardly find more than five in flowers gathered in the country, and then they are . . . . superposed to the sepals, while in others picked at the Museum of Natural History [of Paris] I have sometimes counted as many as twenty. But in all these variations one fact remains constant, and this it is important to note: the stamens are always grouped in five alternipetalous phalanges." Further on the author shows that when there are numerous stamens there are first five in front of the sepals, then a whorl of ten more placed lower down, and then another whorl of five superposed to the first.

side. Sometimes the number of stamens may be still greater. Each consists of a free filament, inserted outside the very thick circular rim of a glandular disk lining the receptacular sac (figs. 381, 382), and of an introrse two-celled anther, dehiscing longitudinally. The gynæceum consists of two or three free carpels inserted in the bottom of the receptacle, each composed of a one-celled ovary tapering above into a style, which passes through the narrow aperture in the disk and ends in a stigmatiferous head. In the internal angle of the ovary is a descending ovule, with its micropyle looking upwards and outwards. The fruit (figs. 383, 384) is made up of two or three achenes, one or two of which are usually sterile, surrounded, as in the Roses, by the receptacular pouch, and crowned by the persistent sepals. But this indusium is dry instead of being fleshy, and the upper part of its outer surface is covered with rigid hooked needles, which existed in the flower, but have grown larger and harder during maturation. In each achene we find a suspended seed, whose coats cover a large, fleshy, exalbuminous embryo, whose radicle is superior.[1] The Agrimonies are perennial herbs, inhabiting the temperate regions of the northern hemisphere; they are also found all over the world, growing on the mountains of even the southern hemisphere.[2] Their aerial branches are covered with alternate imparipinnate leaves, with incised serrate leaflets, and two lateral stipules adnate to the petiole. The flowers are grouped in usually elongated, terminal, simple or slightly ramified racemes, bearing alternate bracts. Axillary to each of these is a flower, with two lateral bractlets, which are rarely fertile.

Some writers have considered a small plant[3] from the Mediter-

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[1] In *A. Eupatoria* the cotyledons have auricles at the base, which partly surround the radicle.

[2] DC., *Prodr.*, *loc. cit.*, 587, 588.—WALLR., *Beitr. z. Bot.*, i. 1-61, t. 1.—C. A. MEY., *Bull. S.-Pét.*, x. n. 22.—WALP., *Rep.*, ii. 37, 914.—GREN. & GODR., *Fl. de Fr.*, i. 561.—HARV. & SOND., *Fl. Cap.*, ii. 290.—TORR. & GR., *Fl. N. Amer.*, i. 430.—A. GRAY, *Man. of Bot.*, ed. 5, 151.—CHAPM., *Fl. S. Unit.-States*, 122.—HOOK. F., in MART., *Fl. Bras.*, *Rosac.*, 67.

[3] This was *Agrimonia agrimonioides* L. *Sp.*, i. 643;—*A. similis* BAUH., *Pin.*, 321;—*Agrimonoides* COLUMN., *Ecphr.*, t. 144;—T., *Instit.*, 301, t. 155). The sepals are valvate or slightly imbricated in the bud. They possess membranous stipules, forming a little calycle of five oppositipetalous pieces. In the cultivated plant, we may often find ten stamens instead of five. As in the true Agrimonies, they are inserted around the very thick rim terminating the disk. The two anther-cells are separated by a pretty broad connective. The gynæceum consists of two, or more rarely of three free carpels; of these the only part that issues from the mouth of the receptacle is the bilabiate stigmatiferous summit. The fruit is dry and glabrous, closely enwrapped in the sac formed by the two bracts that were so much developed even in the flower.

ranean as generically distinct, under the name of *Aremonia*[1] (figs. 385–387). Its flowers have often only five alternipetalous stamens, and are surrounded by a membranous sac, with laciniate edges, embracing the summit of the pedicel, closely applied to the floral receptacle (fig. 387), and formed of two connate bracts accompanying

Agrimonia (Aremonia) agrimonioides.

FIG. 385.
Habit.

FIG. 346.
Flower.

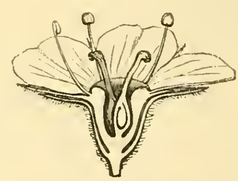

FIG. 387.
Longitudinal section of flower.

each of the flowers. These are borne on pedicels arranged in a short small cluster, terminated by a flower. Thus we see that authors have been justified in restoring[2] *Aremonia* to the genus *Agrimonia*, of which it only constitutes a small section. From its rhizome arise in spring small herbaceous branches, bearing several trifoliolate leaves, each with two lateral stipules. The inflorescence is terminal in the first instance, but from the axils of the leaves may spring younger and poorer clusters of flowers.

Thus constituted, the genus *Agrimonia* consists of only about half a dozen species. These plants may be considered as closely related to the Roses in the general organization of their flowers and fruits;

[1] NECK., *Elem.*, n. 768.—DC., *Prodr.*, ii. 588.—ENDL., *Gen.*, n. 6369.—SPACH, *Suit. à Buffon*, i. 453.—PAYER, *Organog.*, 507, t. ci., f. 13-20.—*Amonia* NESTL., *Pot.*, 17.—*Spallanzania* POLL., *Pl. Nov. Hort. Veron.*, 10; *Giorn. Fis. Par.* (1816), 187, ic.

[2] SIBTH., *Fl. Græc.*, t. 458.—B. H., *Gen.*, 623, n. 52.

they differ in characters, which, though very easy to seize, are yet of no great fundamental value. The chief is the final consistency of the persistent receptacular sac enclosing the true fruits; this is fleshy in the Roses, dry in the Agrimonies, but in either it may bear rigid prickles. Nor can we allow very great value to the reduction in the sexual organs, or the difference in habit and mode of vegetation in the latter genus.

Leucosoidea[1] differs very little from the Agrimonies in the characters of its flower. Here also the receptacular sac persists around the achenes, enclosing them completely; but it becomes very hard, while remaining smooth externally. The sepals are valvate, five or six in number, accompanied by as many alternating leaves of stipular nature,[2] like those we shall observe in the Alchemils. The petals are short, inserted around a thick ring formed by the superior edge of the disk; so, too, are the stamens, from ten to twelve in number, whose introrse anthers bear a circle of glandular projections from the backs of the connectives. The gynæceum is analogous to that of the Agrimonies, being formed of from two to four free carpels, whose ovaries contain a single suspended ovule, and terminate in a filiform style. Only one species of this genus is known, *L. cericea*,[3] a shrub from the Cape of Good Hope, whose leaves are alternate, crowded, imparipinnate, and silky, with unequal incised leaflets, and two adnate petiolar stipules. The flowers are grouped into terminal spikes, each flower axillary to a bract, and accompanied by two sterile bractlets.

The Kousso or Cousso[4] (figs. 388-392), with the floral organization of the preceding genera, but with the very different habit of the Service-trees, has polygamous or diœcious flowers, whose receptacle forms a pouch with a contracted mouth, furnished with a disk projecting into a membranous rim. In the male flowers (figs. 389, 390) this sac is of no great depth, and only contains a rudimentary gynæceum. In the female flowers (figs. 391, 392), on the contrary,

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[1] ECKL. & ZEYH., *Enum. Pl. Cap.*, 265.—ENDL., *Gen.*, n. 6375.—B. H., *Gen.*, 622, n. 52.

[2] It is especially with respect to the Strawberries and Potentils that we shall have to enquire into the signification of the appendages which unite to form what is called a calycle.

[3] ECKL. & ZEYH., *loc. cit.*; Herb., n. 1716.—HARV. & SOND., *Fl. Cap.*, ii. 289.

[4] *Brayera* K., BRAYER, *Notice* (1824); *Dict. Class. d'Hist. Nat.*, i. 501, ic.—DC., *Prodr.*, ii. 588.—SPACH, *Suit. à Buffon*, i. 453.—ENDL., *Gen.*, n. 6395.—B. H., *Gen.*, 622, n. 51.—*Bankesia* BRUCE., *Trav. Nub. & Abyss.*, ed. 2. vii. 181; trad. CASTER., v. 91.—*Hagenia* W., *Spec.*, ii. 331.

it is deeper, and in the bottom are inserted the ovaries, whose styles alone pass through its aperture. The perianth consists of three tetra- or pentamerous whorls, with veined membranous imbricated leaves. The outermost, though larger than the rest, yet constitute a calycle analogous to that of *Leucosidea*. Those of the middle whorl are of the same consistency, but are shorter, and taper towards the base; they form the calyx. The innermost, which are the petals, and may be entirely absent, are short linear caducous scales, or rarely petaloid blades, as long as they are broad, contracted at the base and obtuse at the apex. The stamens are inserted between the perianth and the projecting rim of the disk. They are about twenty in number, each formed in the female flower of a short filament and a little sterile anther; in the male flower of a long exserted filament, originally inflexed in the bud, and an introrse two-celled anther dehiscing longitudinally. The fertile gynæceum consists of two or more rarely three free carpels, with one-celled ovaries and terminal styles, each dilated at the apex into a broad spathulate head, covered with large stigmatic papillæ. In the internal angle of the ovary is a descending incompletely anatropous ovule, whose micropyle looks upwards and outwards.[1] The only species of Kousso as yet known is *Brayera abyssinica*,[2] a tree from the mountainous districts of Abyssinia, whose alternate downy branches are covered with the scars of

Brayera abyssinica.

FIG. 388.
Male inflorescence.

[1] It has not yet been possible to study the ripe fruit and seed.

[2] MOQ., *Bot. Médic*, 217.—*Bankesia abyssinica* BRUCE, *op. cit.*, atl., t. 22, 23.—*Hagenia abyssinica* LAMK., *Dict.*, Suppl., ii. 422; *Ill.*, t. 311.—*Brayera anthelmintica* K., *loc. cit.*—HOOK., *Hook. Journ.*, ii. 349, t. 10.

the older leaves, and bear towards the extremity the young alternate pinnate leaves, crowded together and at a distance recalling those of the Service-tree, with the base of the petiole dilated into a broad incomplete sheath, continuous on each side with a large membranous

Brayera abyssinica.

FIG. 389.
Male flower.

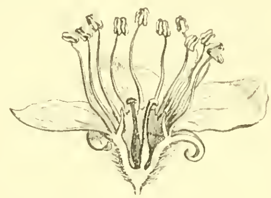

FIG. 390.
Longitudinal section of male flower.

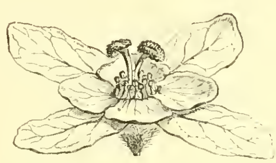

FIG. 391.
Female flower.

FIG. 392.
Longitudinal section of female flower.

stipule. The flowers are in enormous much-ramified clusters of cymes, axillary to the leaves, or terminating the branches. The secondary axes of the inflorescence arise from alternate bracts, which, in the lower part of what is called the panicle, become more and more like leaves, and may even, though smaller, be quite compound like them (fig. 388). Each flower is accompanied by two or three bractlets inserted below the base of its receptacle.

Despite the controversy that has arisen from the different interpretations given to the various parts of the flower in the genera we shall now review, it is convenient to admit, with several contemporary observers, that in the Alchemils[1] (Fr., *Alchimilles*—figs. 393-396) the stamens take the place hitherto occupied by the petals. These plants have hermaphrodite or polygamous flowers. In the former the receptacle forms a sac, widely open above, where the thickened edge of the

[1] *Alchemilla* T., *Instit.*, 508, t. 289.—L., *Gen.*, 165.—ADANS., *Fam. des Pl.*, ii. 294.—J., *Gen.*, 337.—GÆRTN., *Fruct.*, i. 316, t. 73.—LAMK., *Dict.*, i. 277; Suppl., i. 285; *Ill.*, t. 86, 87.—SPACH, *Suit. à Buffon*, i. 483.—DC., *Prodr.*, ii. 589.—ENDL., *Gen.*, n. 6370.—PAYER, *Organog.*, 509, t. ci., figs. 25-40.—B. H., *Gen.*, 621, n. 50.

disk forms a large glandular ring. Without this are inserted the androceum and the perianth. The latter consists of four sepals in most species, especially in the Lady's-mantle (*A. vulgaris*[1] L.—figs. 393, 394). These sepals are valvate in the bud; and outside them we find four alternating stipular bracts forming the calycle.[2] In this species the androceum consists of four alternisepalous stamens, each consisting of a free filament and an introrse anther, which

Alchemilla vulgaris.

Fig. 393.
Flower.

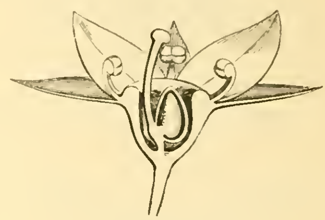

Fig. 394.
Longitudinal section of flower.

dehisces longitudinally by what finally becomes a single cleft. On the filament is a transverse articulation, a little below the anther. The gynæceum of this plant is represented by a single carpel inserted into the bottom of the receptacle, and superposed to one of the stamens. It consists of a unilocular, shortly-stalked ovary, surmounted by a style which is inserted towards the bottom of its internal angle, and terminated, after traversing the orifice of the receptacle, by a stigmatiferous head. Within the ovary, at a point corresponding to the insertion of the style, is a parietal placenta, bearing a descending incompletely anatropous ovule, whose micropyle looks upwards and outwards.[3] The fruit is an achene, surrounded by the sac formed by the dried-up receptacle. The exalbuminous seed contains a fleshy embryo with its radicle superior. The other species of this genus may differ from *A. vulgaris* in the following respects.—The bracts of the calycle may be equal in

[1] L., *Spec.*, 178.—DC., *Prodr.*, n. 2.

[2] We cannot consider this organ as a calyx, and the inner envelope as a corolla, as has been supposed, for the leaves of the calycle do not appear till after the true perianth, which is of calycinal nature.

[3] It has but one coat. It has been described as ascending, but its raphe, short though it be, descends from the point of insertion; and that is the peculiarity of descending ovules. The apparently ascending direction here observed is due to the slightness of the anatropy of the ovule. Only at first, while it is still orthotropous, is the ovule of *Alchemilla* ascending.

length to the sepals, and quite similar to them. The number of stamens may be reduced to one or two; this is usually the case in *Aphanes*[1] (figs. 395, 396), formerly made into a distinct genus. Finally, there may be two, three, or four carpels in each flower. About thirty species of this genus[2] are known, especially common in the Andes[3], from Mexico to Chili,[4] more rare at the Cape,[5] in Australia[6] and Madagascar, and in Europe[7] and Asia[8] in the northern hemisphere. They are herbs, more frequently perennial than annual, possessing alternate leaves with two cauline stipules forming a sheath, and digitate or palmatipartite blade. The flowers are small and greenish, grouped on a common peduncle into ramified cymes, often becoming uniparous by abortion towards their extremities.

Alchemilla (*Aphanes*) *arvensis*. (*Parsley Piert.*)

Fig. 395. Flower.

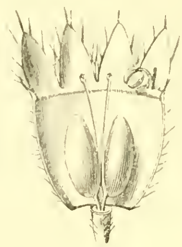

Fig. 396. Flower opened out.

In the Burnets[9] (Fr., *Pimprenelles*—figs. 397–406) there is nothing occupying the place of a corolla. The receptacle still forms a sac, as in the preceding plants; it persists around the fruits, and is thinly membranous, corky, or sometimes even slightly fleshy. Its surface is smooth, as in the Alchemils, or is covered with prickles, which, though smaller, recall those of the Agrimonies; but the number of carpels is much reduced, and there are normally four perianth-leaves. The number of stamens is sometimes well defined, as in certain Alchemils; and this, indeed, is the peculiar character of the species of *Sanguisorba*,[10] from which genus, as we shall soon see, it is impossible to separate *Poterium* properly so-called. If, for instance, we examine the flowers of

[1] L., *Gen.*, 166.

[2] DC., *Prodr.*, loc. cit.—Walp., *Rep.*, ii. 42, 914; v. 655; *Ann.*, i. 280; ii. 519; iii. 855.

[3] Wedd., *Chlor. And.*, ii. 244, t. 75.

[4] H. B. K., *Nov. Gen. et Spec.*, vi. 223, t. 560, 561.—C. Gay, *Fl. Chil.*, ii. 301.—Torr. & Gr., *Fl. N. Am.*, i. 432; ap. Wippl., 164.—A. Gray, *Man. of Bot.*, ed. 5, 151.—Chapm., *Fl. S. Unit.-States*, 122.—Seem., *Herald*, 282.—Presl., *Epimel.*, 199.

[5] Harv. & Sond., *Fl. Cap.*, ii. 291.

[6] Benth., *Fl. Austral.*, ii. 432.

[7] Gren. & Godr., *Fl. de Fr.*, i. 564.—Reichb., *Pl. Crit.*, i. t. 4.

[8] Wight, *Icon.*, t. 229.

[9] *Pimpinella* T., *Instit.*, 156, t. 68.—Adans., *Fam. des Pl.*, ii. 293.—Gærtn., *Fruct.*, i. 161, t.32 (nec L.).—*Poterium* L., *Gen.*, n. 1069.—J., *Gen.*, 336.—Lamk., *Dict.*, v. 327; Suppl., iv. 415; *Ill.*, t. 777.—DC., *Prodr.*, ii. 594.—Spach, *Suit. à Buff.*, i. 487.—Endl., *Gen.*, n. 6374.—Payer, *Organog.*, 512, t. ciii.—B. H., *Gen.*, 624, n. 57.

[10] L., *Gen.*, n. 146.—J., *Gen.*, 336.—Gærtn., *Fruct.*, i. 161, t. 32.—Lamk., *Dict.*, vi. 496; *Ill.*, t. 85.—Turp., *Dict. des Sc. Nat.*, t. 240.—DC., *Prodr.*, ii. 593.—Spach, *Suit. à Buffon*, i. 486.—Endl., *Gen.*, n. 6373.

the Great Burnet[1] (Fr., *Grande Pimprenelle*; figs. 397–399), we shall see that they are hermaphrodite, regular, and apetalous, with the calyx and androceum tetramerous. The receptacle forms a sac, whose

Sanguisorba officinalis.

FIG. 398.
Flower.

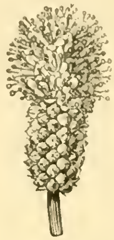

FIG. 397.
Inflorescence.

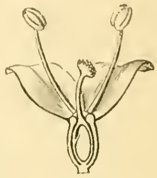

FIG. 399.
Longitudinal section of flower.

opening is narrowed by the swollen borders of the disk, projecting more opposite each sepal than in the four intervals. The four calyx-leaves are inserted on the rim of the receptacle—one anterior, one posterior, and two lateral, which are overlapped by the two former in the bud.[2] The four stamens are also inserted in the throat of the receptacle, superposed to the sepals; each consists of a free

Sanguisorba Poterium.

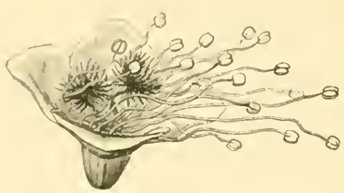

FIG. 401.
Hermaphrodite flower.

FIG. 400.
Inflorescence.

FIG. 402.
Long. section of hermaphrodite flower.

filament, and an introrse two-celled anther, dehiscing longitudinally. The gynæceum consists of a single carpel alternating with two of the sepals[3] (and consequently with two stamens) inserted in the bottom of the receptacular sac. Its ovary is free, one-celled, sur-

[1] *Sanguisorba officinalis* L., *Spec.*, 169.—*S. sabauda* MILL., *Dict.*, n. 2.

[2] The overlapped edges of the sepals are more membranous and coloured, and thinner than the overlapping edges, and still more so than the midribs.

[3] PAYER (*op. cit.*, 513) says that it is alternate "with the anterior sepal on the one hand, and one of the lateral sepals on the other."

mounted by a terminal style, which passes through the narrow orifice of the receptacle to terminate in an enlarged stigmatiferous head, whose form has been compared to a bottle-brush. On one side the ovary presents a longitudinal furrow externally; here the inner wall bears an ovule descending into the single cavity; it is anatropous, with its raphe looking towards the placenta, and the micropyle superior and dorsal.[1] The fruit is an achene surrounded by the receptacular sac, which is now thick and hard, with a wrinkled surface marked by four more or less prominent ridges. Within the membranous seed-coats is a fleshy exalbuminous embryo with its radicle superior. *Sanguisorba officinalis* is a perennial herb possessing alternate imparipinnate leaves, with petiolulate leaflets, and two lateral stipules adnate to the base of the petiole; while the flowers are in terminal spikes,[2] which are often themselves collected into cymes. Each flower is axillary to a mother-bract, and possesses two lateral bractlets which are normally sterile.

Sanguisorba and *Poterium* have been, and are still, considered to form two distinct genera, because the latter have usually unisexual or polygamous flowers, indefinite elongated stamens, and two or three carpels. When, however, we examine the numerous species of *Poterium* described by authors, we find that they may have all their flowers hermaphrodite, and that the number of carpels is very variable, and may be reduced to one. The stamens are very numerous, it is true, in *P. Sanguisorba* (Salad Burnet, Garden Burnet—figs. 400–404) and the allied species, and their long filaments hang down on one side in the expanded flower. But these become shorter as the anthers are less developed and gradually tend towards complete sterility, when they may stand erect, as in *Sanguisorba*. At the same time the number of stamens may be reduced, so that

Sanguisorba Poterium.

FIG. 403.
Female flower.

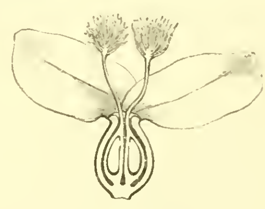

FIG. 404.
Longitudinal section of female flower.

[1] It has only a single coat.

[2] The flowers expand successively, not as is usually the case with spikes from base to apex, but more frequently, if not constantly, from above downwards, beginning either at the tip or in a zone at a variable distance from it (fig. 397).

certain species have only ten or twelve, or even five or six.[1] Thus the differences formerly pointed out between these two genera gradually disappear, and they become quite inseparable.

Thus constituted, this generic group contains about fifteen species found native in all the temperate and warm regions of the northern hemisphere.[2] Nearly all are herbaceous and perennial; one alone is annual, and has been made the type of a distinct genus under the name of *Poteridium*.[3] *P. spinosum*[4] is frutescent, and its aborted branches are to some extent transformed into spines. Its floral receptacle becomes thicker and fleshier than in the other species. Hence the generic name of *Sarcopoterium*[5] proposed for this species.

Sanguisorba (*Poterium*) *polygama*.

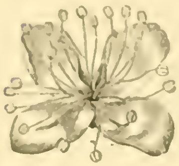

FIG. 405. Hermaphrodite flower.

FIG. 406. Heptandrous flower.

The flowers of *Polylepis*[6] have the receptacle and indefinite stamens of *Poterium*. The calyx has from three to five leaves, slightly imbricated when young, but, as a rule, finally becoming valvate. The carpels are usually solitary; but this is not constant, some flowers possessing two or three carpels; they are in other respects those of *Poterium*. The receptacle forms a sac around them in the fruit, and is marked by longitudinal projecting lines, here and there inter-

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[1] So too there are true *Sanguisorbas* whose specific name indicates the general number of stamens, such as *S. dodecandra* MORETT., *decandra* WALL., &c. These stamens are also longer. In the species of the section or subgenus *Poterium*, such as *P. Sanguisorba* L., *ancistroides* DESF., &c., there are almost always male flowers at the base of the spike, female flowers at the apex, and between them a variable number of completely or incompletely hermaphrodite flowers with ten or twelve stamens (fig. 405) or even only half a dozen (fig. 406); they are then shorter than in the male flowers. In the hermaphrodite flowers the gynæceum may have a sterile ovary, but the style and stigma are pretty well developed. In many species, too, the expansion of the flowers begins as described in the text. The fruit is the organ subject to the greatest variations in *Poterium*; and SPACH, in founding subdivisions in this group, has chiefly regarded the outer surface of the indusium, whether reticulate, rugose, muricate, warty, or veined, or more or less marginate or four-winged.

[2] DC., *Prodr.*, ii. 593–595.—WALP., *Rep.*, ii. 44; *Ann.*, i. 282; iii. 855; iv. 665.—DESF., *Fl. Atlant.*, ii. 346, t. 251.—TORR. & GR., *Fl. N. Amer.*, i. 428.—SPACH, *Revis. Gen.* Poterium, *Ann. Sc. Nat.*, sér. 3, v. 31.—GREN. & GODR., *Fl. de Fr.*, i. 562.—A. GRAY, *Man. of Bot.*, ed. 5, 150.—CHAPM., *Fl. S. Unit.-States*, 122.—HARV. & SOND., *Fl. Cap.*, ii. 292.—MIQ., *Mus. Lugd. Bat.*, iii. 38.—THW., *Enum. Pl. Zeyl.*, 102.—A. BR., *App. Hort. Berol.* (1867), 10.

[3] SPACH, *Ann. Sc. Nat.*, sér. 3, v. 43 (*Sanguisorba annua* TORR. & GR., *Fl. N. Amer.*, i. 429;—*Poterium annuum* NUTT.).

[4] L., *Spec.*, 1411.—DC., *Prodr.*, n. 1 (sect. *Leiopoterium*).—SIBTH., *Fl. Græc.*, t. 943.

[5] SPACH, *Ann. Sc. Nat.*, loc. cit.

[6] R. & PAV., *Prodr.*, *Fl. Per. et Chil.*, 34, t. 15.—DC., *Prodr.*, ii. 591.—ENDL., *Gen.*, n. 6377.—B. H., *Gen.*, 623, n. 55.

spersed with very unequal prickles. This genus *Polylepis* includes half a score species,[1] trees from the temperate regions of the Andes, growing in Bolivia, Peru, and Colombia. The branches are often denuded and twisted; the leaves are alternate, with two adnate stipules, and a trifoliolate or imparipinnate blade. The flowers are in lax pendulous racemes, each flower axillary to a bract, and with two lateral bractlets.

In *Bencomia*[2] we find the pinnate leaves of certain species of *Polylepis*, and their flowers in long pendulous spikes. But these flowers are diœcious. In the female alone is there a receptacular sac, lodging from two to four carpels in its concavity. The males lack this concavity in the receptacle; they possess a calyx composed, as in the females, of from three to five imbricated leaves, and an androceum like that of *Poterium* or *Polylepis*, formed of a variable number of free stamens. We know of two frutescent species of *Bencomia*,[3] natives of Madeira and the Canary Islands. The genus is closely allied to the preceding, and might perhaps be united to it simply as a distinct section. The male flower at the same time closely recalls what we shall find in *Cliffortia*.

Acæna sericea.

Fig. 407. Flower.

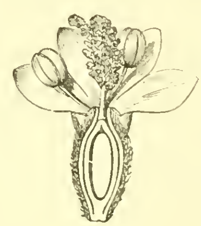

Fig. 408. Longitudinal section of flower.

Acæna[4] (figs. 407, 408) has the same receptacle, disk, and insertion; the calyx has no calycle, and consists of three or four, or rarely more leaves; these are slightly imbricated in the very young bud, but early cease to overlap. The stamens are inserted on a level with the sepals and superposed to them; but are rarely found in equal or larger numbers. For more frequently there are only two or three of the sepals which have each in front of their middle lines one of these organs,[5] formed of a slender free filament and a two-celled

[1] H.B.K., *Nov. Gen. et Spec. Pl. Æquin.*, vi. 179.—Wedd., *Chlor. And.*, ii. 237, t. 78.

[2] Webb, *Phytog. Canar.*, ii. t. 39.—Spach, *Ann. Sc. Nat.*, sér. 3, v. 43.—B. H., *Gen.*, 624, n. 58.

[3] Ait., *Hort. Kew.*, iii. 354.—Coll., *Hort. Ripul.*, 112, t. 40.—DC., *Prodr.*, ii. 594, n. 2. —Hook., *Bot. Mag.*, t. 2341.—Lowe, *Fl. Mader.*, 240.

[4] Vahl, *Enum.*, i. 273.—L., *Mant.*, 200.—J., *Gen.*, 336.—Lamk., *Dict.*, i. 25; Suppl., i. 86.—Endl., *Gen.*, n. 6372.—Spach, *Suit. à Buffon*, i. 453.—B. H., *Gen.*, 623, n. 56.—*Ancistrum* Forst., *Char. Gen.*, 3, t. 2.—Gærtn., *Fruct.*, i. 163, t. 32.—Lamk., *Dict.*, i. 148; Suppl., i. 344; *Ill.*, t. 22, fig. 1.

[5] We may even find monandrous flowers, and that too in species with as many as three or four stamens normally.

anther, dehiscing by two introrse or lateral clefts. In the bottom of the receptacular sac we observe one or two carpels of *Sanguisorba*. The fruits are achenes, surrounded by the floral receptacle, whose outer surface rarely remains smooth, being usually covered with prickles, furnished at the tip with rigid, obliquely-reflexed hairs; so that each prickle is barbed like a little harpoon. In certain species the prickles are unequal and scattered over the whole surface.[1] But in a larger number they are as numerous as the sepals, arising from the upper part of a rib continuous with the midrib of the sepal; in this case they are far better developed, and rise up more or less obliquely outside the calyx.[2] *Acæna* comprises about thirty species of herbs or undershrubs from the cold and temperate regions of both hemispheres,[3] chiefly the southern, inhabiting especially South America[4] and Oceania.[5] Their leaves are alternate, imparipinnate, with two petiolary stipules. The flowers are in continuous or interrupted heads or spikes, at the summit of a usually terminal axis, naked below.

Margyricarpus[6] (figs. 409, 410) has hermaphrodite flowers, with the same elongated, narrow-mouthed receptacular sac. In the bottom of it we find a single carpel, with one suspended ovule in its ovary. On the rim of the opening, which is almost completely closed up by the glandular layer lining the receptacle and only leaving a narrow orifice for the style to pass through, are inserted from three to five (usually four) imbricated sepals, but no calycle. Interior to these are from one to three stamens, with slender filaments and introrse two-celled anthers. The outer surface of the receptacle bears four prominent vertical ridges, answering to the midribs of the sepals. In one species of this genus, which has been separated under the name *Tetraglochin*,[7] each ridge later on becomes a

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[1] The distinctive character of the section *Euacæna* (DC.).

[2] This occurs in *Ancistrum*, made a distinct section by DE CANDOLLE; but we find every transition between these localized prickles, and the scattered ones of *Euacæna*. These rigid rectilinear prickles are often covered with very stiff, acute, reflexed hairs, altogether giving the prickles the look of a many-barbed harpoon.

[3] WALP., *Rep.*, ii. 43; v. 655; *Ann.*, i. 280; ii. 519; iii. 855; iv. 664.—VENT., *Hort. Cels.*, t. 6.—LINDL., *Bot. Reg.*, t. 1271.—HARV. & SOND., *Fl. Cap.*, ii. 290.

[4] VAHL., *Enum.*, 294.—R. & PAV., *Fl. Per. et Ch.*, i. 67, t. 103, 104.—H. B. K., *Nov. Gen. et Sp.*, vi. 182.—C. GAY, *Fl. Chil.*, ii. 282.—WEDD., *Chlor. And.*, ii. 238, t. 76.

[5] FORST., *loc. cit.*—HOOK. F., *Fl. Antarct.*, p. ii. 9, t. xciv.-xcvi.—BENTH., *Fl. Austral.*, ii. 433.

[6] R. & PAV., *Prodr.*, vii. t. 33; *Fl. Per. et Chil.*, i. 28, t. 8, fig. d.—LAMK., *Dict.*, Suppl., iii. 589.—DC., *Prodr.*, ii. 591.—ENDL., *Gen.*, n. 6378.—SPACH, *Suit. à Buffon*, i. 485.—B. H., *Gen.*, 623, n. 54.—*Empetri* spec. LAMK., *Dict.*, i. 567.—*Ancistri* spec. LAMK., *Ill*, i. 77.

[7] PŒPP., *Fragm. Synops.*, 26.—ENDL., *Gen.*, n. 6376.—WEDD., *Chlor. Andin.*, ii. 236, t. 77.

wing extending the whole length of the fruit. But in *Margyricarpus* proper they are only developed under the base of the sepals, forming some little unequal obtuse prickles. All the rest of the receptacle gradually becomes thick and quite fleshy, to form a nearly globular indusium around the true fruit. This is an achene with a hard, thick pericarp, and a suspended seed with a fleshy exalbuminous embryo. The genus consists of stiff, bushy shrubs from the Andine regions of South America,[1] with alternate leaves dilated at the base into a petiole, which forms an incomplete sheath, and is continuous at the edges with two broad membranous stipules. The blade of the leaf is either well-developed and imparipinnate, or to a great extent abortive, the hardened midrib being transformed into a spine. The flowers are inconspicuous, solitary, axillary, and sessile.

Margyricarpus setosus.

Fig. 409.
Floriferous branch.

Fig. 410.
Fruit.

Cliffortia[2] (figs. 411, 412) represents the most reduced type found in the order *Rosaceæ*. The flowers are diœcious, with either only stamens or only a gynæceum in a simple floral envelope. In the male flower (fig. 411) the receptacle is not concave; it is the unmodified apex of a short axis, bearing a calyx of three or four imbricate leaves. The stamens are indefinite. Their filaments, inserted in the centre of the flower, are unequal free and slender, bent on themselves in the bud. The anthers are two-celled, often didymous, dehiscing by two introrse or marginal clefts. The female flower has a similar calyx, but its sepals are inserted on the edges of the narrow orifice of a receptacle like that of *Acæna*, *Margyricarpus*, or

[1] H. B. K., *Nov. Gen. et Spec.*, vi. 180.—W., *Nov. Act. Nat. Cur.*, iii. 437.—C. Gay, *Fl. Chil.*, ii. 278, 280.

[2] *Cliffortia* L., *Gen.*, n. 1133; *Hort. Clifford.*, t. 30, 31.—Adans., *Fam. des Pl.*, ii. 293.—J., *Gen.*, 337.—Lamk., *Dict.*, ii. 46; Suppl., ii. 299; *Ill.*, t. 827.—DC., *Prodr.*, ii. 595.—Endl., *Gen.*, n. 6379.—Spach, *Suit. à Buffon*, i. 489.—B. H. *Gen.*, 625, n. 59.—*Morilandia* Neck., *Elem.*, n. 766.—*Nenax* Gærtn., *Fruct.*, i. 165, t. 32.—*Monographidium* Presl., *Epimel.*, 202.

Sanguisorba. This orifice is almost entirely closed by the thickened edge of a glandular disk, and here one may often observe a variable number of tiny scales, representing rudimentary stamens. In the bottom of the sac are inserted either one or two carpels, with an ovary like that of *Poterium,* and a style, which, at first recurved in the bud, afterwards becomes erect to form a long, exserted, thick tongue, one side of which is thickly covered with a papillose, plumose tissue. The fruit consists of one or two achenes enclosed in the receptacular sac, which has now become thick and coriaceous or horny, or more rarely corky or almost fleshy, and is itself surrounded by the persistent calyx, closely applied to its outer surface. The seeds are pendulous, with membranous coats and an embryo with thick, fleshy cotyledons and a superior radicle.

Cliffortia ilicifolia.

FIG. 411. Male flower.

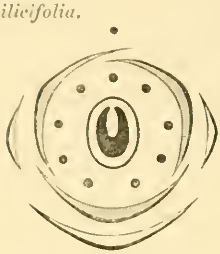

FIG. 412. Diagram of female flower.

Cliffortia consists of shrubs from the south of Africa,[1] whose leaves are alternate, often crowded, with two lateral adnate stipules and a blade of very variable form, in some species recalling that of the Apple or the Elm, in others resembling the leaf-like branches of *Ruscus* (Butcher's Broom), or the leaves of the *Proteaceæ, Dracophyllum, Styphelia,* or even of the *Dracæneæ.* DE CANDOLLE[2] has shown how these modifications pass into one another, while using them to subdivide the genus into sections.[3] According to him all the species have alternate leaves; in those described as having them fascicled they are really trifoliolate; as indeed they are in those described as having opposite leaves, but here the lateral leaflets are alone developed. The flowers are sessile, or nearly so, solitary or in pairs in the axils of the leaves.

[1] THUNB., *Prodr. Fl. Cap.,* 93.—W., *Spec.,* iv. 838.—SPRENG., *N. Ent.,* ii. 174. HARV., *Thes. Cap.,* t. 95.—HARV. & SOND., *Fl. Cap.,* ii. 292 (nec 597).

[2] *Note sur le feuillage des* Cliffortia, *Ann. Sc. Nat.,* sér. 1, i. 447.

[3] 1. *Multinerviæ.* 2. *Dichopteræ.* 3. *Tenuifoliæ.* 4. *Latifoliæ.* 5. *Bifoliolæ.*

III. STRAWBERRY SERIES.

The Strawberries[1] (Fr., *Fraisiers*—figs. 413–419) have regular

Fragaria vesca (*Common Strawberry*).

FIG. 413.
Habit.

FIG. 414.
Flower.

FIG. 417.
Carpel.

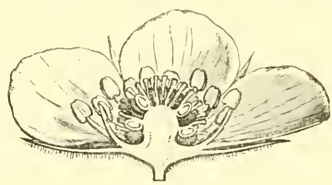

FIG. 416.
Longitudinal section of flower.

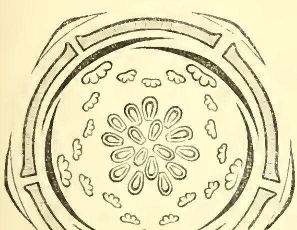

FIG. 415.
Diagram.

FIG. 418.
Longitudinal section of carpel.

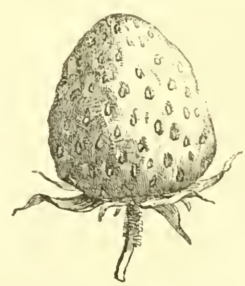

FIG. 419.
Fruit.

polygamous or hermaphrodite flowers. In the latter we observe a

[1] *Fragaria* T., *Inst.*, 295, t. 152.—L., *Gen.*, n. 633.—ADANS., *Fam. des Pl.*, ii. 294.—J., *Gen.*, 338.—GÆRTN., *Fruct.*, i. 350, t. 73.—LAMK., *Dict.*, ii. 527; Suppl., ii. 667; *Ill.*, t. 442.—NESTL., *Potent.*, 17.—DC., *Prodr.*, ii. 569.—SPACH, *Suit. à Buffon*, i. 462.—ENDL., *Gen.*, n. 6361.—B. H., *Gen.*, 620, n. 47.

receptacle like a very flat cup with a circular rim, and the bottom pushed up in the middle like that of a wine-bottle. On this central projection, the true organic apex of the receptacle, are borne the carpels, while the perianth and androecum are inserted on the edges. The calyx consists of five sepals, valvate and slightly reduplicate in the bud, or rarely a little imbricated. Outside the calyx are five leaves alternating with the sepals, and forming what is called the calycle.[1] The petals, alternate with the sepals, are shortly unguiculate, imbricated in the bud. The stamens are usually twenty in number, and are in this case arranged in three whorls; there are five, each in front of the median line of a sepal, then as many in front of the petals, and lastly, ten others, one on either side of each of the latter.[2] Each consists of a free filament and an introrse or sublateral two-celled anther, dehiscing longitudinally.[3] A glandular disk, more or less marked, lines the inside of the receptacle from the insertion of the stamens to the central prominence, which is covered by the indefinite carpels. These last are free, each consisting of a one-celled ovary, surmounted by a style which is inserted at a variable height on the ventral angle of the ovary, and gradually widens out towards its truncate stigmatiferous summit. Inside the ovary, about half-way up the ventral angle,[4] is inserted a descending subanatropous ovule, whose micropyle looks upwards and outwards[5] (fig. 418). The fruit is multiple, composed of a large number of achenes,[6] borne on the prominent part of the receptacle, now much thickened,[7] fleshy, and succulent.[8] The calyx and involucre persist at the base of this

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[1] These are of stipular nature, each being formed by the fusion of two adjacent stipules. Indeed, very frequently this fusion does not take place, and the calycle consists of ten leaves, in free or cohering pairs alternate with the sepals (see PAYER, *Elém. de Bot.*, 90, figs. 143, 144). In one yellow-flowered species, *F. indica* DC. (*Prodr.*, ii. 571), which SMITH (*Trans. Linn. Soc.*, x. 372;—WALP., *Ann.*, iv. 663) proposed to make the type of a distinct section under the name of *Duchesnea*, the leaves of the calycle are broad and with incised edges, and are far larger than the sepals themselves.

[2] When there are more than twenty stamens it is due to the occurrence of more or less numerous deduplications, so that in several whorls two or three of these organs may occupy the place of a single one.

[3] The pollen is ellipsoidal with three longitudinal grooves, which in water become as many bands, sometimes smooth, sometimes papillose. We meet with nearly the same organization in nearly all the genera of this series—*Potentilla*, *Geum*, *Dryas*.

[4] The insertion of the ovule is lower down according as that of the style (the true organic apex of the ovary) approaches the base. Thus, in *F. indica* the style is attached at the junction of the superior and middle thirds of the ovary; the ovule is here very distinctly descending, and its anatropy is far more perfect than where the style is inserted lower down.

[5] The ovule has a single coat.

[6] More frequently they are true drupes; but the mesocarp is very thin.

[7] Usually it rises up in the intervals between the fruits, so that they are inserted in little pits. But sometimes, as in *F. indica*, this insertion is on slight prominences of the receptacle.

[8] It may be harder and almost fibrous, of a

multiple fruit, and each achene encloses a seed, containing a fleshy exalbuminous embryo, with its radicle superior.

The Strawberries are perennial herbs; the stem is a short sympodium,[1] and the leaves are alternate, trifoliolate, digitate, or rarely pinnate, with two lateral petiolary stipules. The branches are often prolonged into runners with scattered leaves, whose axillary buds strike root in contact with the soil[2] (fig. 413). The flowers are terminal, solitary, or more frequently collected into alternate, few-flowered, often uniparous cymes at the summit of a common peduncle. A large number of species have been described, inhabiting all the temperate and alpine regions of the northern hemisphere, and the mountains of South America and the Mascarene Islands.[3] But most of these are only forms or varieties, and there are probably not half a dozen true species.

The Potentils[4] (figs. 420–427) come very near to the Strawberries in their perianth and androceum;[5] and the true species are only distinguished by two characters, which are sometimes very ill-marked.[6] The style is usually inserted higher up on the ovary, and so the

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similar consistency to that of *Comarum*. When it is not very fleshy the achenes may separate from it when quite ripe, as in certain Potentils.

[1] IRM. (T.), *Bot. Zeit.*, viii. 250.—WYLD., *Flora*, xxxiv. 364.—GREN., *Bull. Soc. Bot. de Fr.*, ii. 349.—J. GAY, *Ann. Sc. Nat.*, sér. 4, viii. 185.

[2] A. S. H., *Morph. Vég.*, 235.—A. JUSS., *Elém.*, 156.—PAYER, *Elém.*, 58, fig. 93.

[3] DUCH., *Hist. Nat. des Frais.*, 1766.—FRENZ., *Frag.*, 1662.—L., *Fraga vesca*, 1772.—DC., *Prodr.*, ii. 569.—LOUR., *Fl. Coch.*, 325.—ROXB., *Fl. Ind.*, ii. 520.—WIGHT & ARN., *Prodr.*, *Fl. Pen. Ind.*, i. 300.—WIGHT, *Icon.*, t. 988, 989.—MIQ., *Fl. Ind. Bat.*, i. p. i. 371.—H. B. K., *Nov. Gen. et Spec.*, vi. 172.—C. GAY, *Fl. Chil.*, ii. 315.—TORR. & GR., *Fl. N. Amer.*, i. 447.—A. GRAY, *Man. of Bot.*, ed. v. 155.—J. GAY, *loc. cit.*, 194.—WALP., *Rep.*, ii. 25; *Ann.*, i. 277.

[4] *Potentilla* T., *Inst.*, 295, t. 153.—L., *Gen.*, n. 634.—J., *Gen.*, 338, 453.—GÆRTN., *Fruct.*, i. 350, t. 73.—LAMK., *Dict.*, ii. 527; Suppl., ii. 667, *Ill.*, t. 442.—NESTL., *Mon.* Potent., 1816.—LEHM., *Mon.* Potent., 1820-35.—DC., *Prodr.*, ii. 571.—SPACH, *Suit. à Buffon*, i. 469.—ENDL., *Gen.*, n. 6363.—B. H., *Gen.*, 620, n. 48.—*Quinquefolium* T., *Inst.*, 296, t. 153.—*Pentaphylloides* T., *op. cit.*, 298.—ADANS., *Fam. des Pl.* ii. 295.—GÆRTN., *Fruct.*, i. 349, t. 73.—*Fragariastrum* SCHKUR, *Enum. Plant. Transylvan.*, 137.—*Bootia* BIG., *Fl. Bost.*, 351.

[5] The number of stamens is here as variable as in *Fragaria*. A. DICKSON, who has studied the arrangement of the stamens in *Rosaceæ* generally very fully (see *Journ. of Bot.*, iii. (1865), 209), and confirmed most of the results obtained by PAYER on this subject by organogenic study (see p. 337, note 1), has especially determined the number of pieces in the androceum and their arrangement in *Potentillas* (*On the Staminal Arr. in some Spec. of* Potent., *and in* Nuttallia cerasiformis; *Journ. of Bot.* iv. (1866), t. lii.). He has shown that in certain species, such as *P. fruticosa*, the androceum forms five festoons, each containing four or five stamens, and extending from petal to petal; the convexity of the festoons is towards the centre of the flower, and there are no stamens superposed to the sepals. On these grounds the author considers the androceum as formed of five compound stamens, the terminal lobe of each being developed as a petal so called, and the lateral lobes as fertile stamens. In other species, where he finds a stamen exactly superposed to a sepal, he considers it the representative in the androceum of one of the calycular leaves, which are of stipular nature, and hence alternate with the sepals just as the oppositisepalous stamens alternate with the oppositipetalous staminal bundles.

[6] So ill-marked indeed that we should certainly be consistent in refusing to retain *Fragaria* and *Potentilla* as distinct genera.

ovule is more distinctly pendulous and more perfectly anatropous. Moreover, the receptacle does not become as thick and succulent as in the Strawberries, generally remaining dry and covered with hairs. To this genus we add below, as so many sections, a certain number of aberrant types.

Potentilla reptans (*Cinquefoil*).

FIG. 420.
Habit.

We may clearly see how badly the character of the consistency of the receptacle distinguishes the Strawberries, and that the two genera should strictly be united into one, for *Comarum*,[1] of which one species is found in marshy places over a large part of Europe, has fruits with a spongy receptacle, not so dry as in most Potentils, or so fleshy as in most Strawberries.

Trichothalamus[2] is *Potentilla* in which the hairs covering the receptacle are longer and more numerous than in the other species. It cannot be separated from the genus any more than *Tormentilla*,[3] whose flower is usually tetramerous, a number only exceptionally found in some other species.

The androceum is reduced in some of the true Potentils, as indicated by the specific name of *P. pentandra*.[4]

Here, as in the Strawberries, the habit may vary very much. There are woody or suffrutescent species like *P. arbuscula*, *fruticosa*,

[1] L., *Gen.*, n. 638.—GÆRTN., *Fruct.*, i. 349, t. 73.—TORR. & GR., *Fl. N. Am.*, i. 447.—ENDL., *Gen.*, n. 6362. The purple colour of the petals of *C. Palustre* L. (*Spec.*, 718;—*Potentilla Comarum* SCOP., *Fl. Carniol*, ed. 2, v. i. 359;—*P. rubra* HALL. F., SER. *Mus. Helv.*, i. 56;—*P. palustris* LEHM., *Pol.*, 52), is insufficient to distinguish it from all the other Potentils. But it is noteworthy that the stamens are usually twenty in number, and that the five outermost, superposed to the sepals, are reflexed to such an extent that their anthers become extrorse, at least at the season of fertilization. The five leaves of the calycle are often deduplicated. The carpels are very numerous.

[2] LEHM., *Nov. Act. Acad. Cæsar.*, x. 585. t. 49.—*Lehmannia* TRATT., *Ros. Monogr.* iv. 144.

[3] *Tormentilla erecta* L. (*Spec.*, 716;—*T. officinalis* SM., *Engl. Bot.*, t. 863;—*Potentilla Tormentilla* NESTL., *Mon.*, 65.—SCHRANCK, ex LEHM., *Mon.*, 149;—DC., *Prodr.*, n. 18;—*P. tetrapetala* HALL. F., SER. *Mus. Helv.*, i. 51;—*P. nemoralis* NESTL., *loc. cit.*).

[4] See BENTH. & HOOK., *Gen.*, 621.

&c. In others the stems and branches are slender and spread along the ground (fig. 420), or form runners, just as in the Strawberries. The leaves are very variable in form, for besides the exceptional forms of the degenerated types that we shall unite to the genus *Potentilla*, there are species with imparipinnate leaves, and others with digitate leaves, as indicated by the generic name *Dactylophyllum*.[1]

There are Potentils in which the androceum is reduced to fifteen, ten, or even five stamens. Take for instance the American plants, of which it has been proposed to make the genera *Horkelia*[2] and

Potentilla (*Horkelia*) *congesta*.

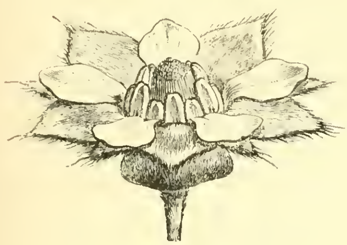

FIG. 421.
Flower.

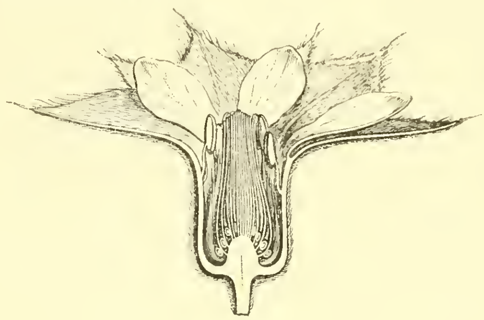

FIG. 422.
Longitudinal section of flower.

Ivesia[3]: *I. santolinoides*[4] has fifteen stamens; *H. congesta*,[5] *cuneata*,[6] *tridentata*[7] have ten—five superposed to the sepals, five to the petals. *H. Gordoni*[8] has only five, superposed to the sepals. In the *Horkelias* and *Ivesias* first known, this character, not of sufficient value in itself, was accompanied by others which then justified the establishment of new generic divisions; but they have been found not to be constant in the species more recently studied, and can only serve to mark out secondary divisions in the genus *Potentilla*. These characters

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[1] SPENN., *Fl. Friburg.*, iii. 1034 (*P. procumbens* CLAIRV., ex DC., *Prodr.*, ii. 587;—*Sibbaldia procumbens* L., *Spec.*, 406).

[2] CHAM. & SCHLTL., *Linnæa*, ii. 26.—TORR. & GR., *Fl. N. Amer.*, i. 434.—HOOK., *Bot. Mag.*, t. 2880.—LINDL., *Bot. Reg.*, t. 1997.—ENDL., *Gen.*, n. 6364.—TORR. & GR., ap. WIPPL., 164, t. 6.—A. GRAY, *Proceed. Amer. Acad.*, vi. 528; vii. 336.—B. H., *Gen.*, 621.

[3] TORR., ap. WIPPL., ii. t. 4.—TORR. & GR., *Bot. Pacif. Exp.*, vi. 72.—A. GRAY, *Proceed. Amer. Acad.*, vi. 530; vii. 337.

[4] A. GRAY, *loc. cit.*, 531.—*I. gracilis* TORR. & GR., *Newb. Rep.*, t. 11.—*Potentilla Newberryi* A. GRAY, *loc. cit.*

[5] HOOK., *Bot. Mag.*, *loc. cit.*

[6] LINDL., *loc. cit.* (*H. californica* CH. & SCHLTL., *Linnæa*, *loc. cit.*, nec aliorum).—*H. grandis* HOOK. & ARN.—*H. capitata* TORR. ap. WIPPL., *loc. cit.* (nec LINDL.).

[7] TORR., ap. WIPPL., *loc. cit.*

[8] HOOK., *Hook. Journ.*, v. 341, t. 12.—*H. millefoliata* TORR.—*Ivesia Gordoni* TORR. & GR., ap. NEWB., 6, 72.

are to be seen in the conformation of the androceum and the receptacle, and in the number of parts in the gynæceum. The anthers are sometimes oval or oblong in *Horkelia*, as in *H. congesta, cuneata*, sometimes didymous, as in *H. tridentata, Gordoni*, as well as in *Ivesia santolinoides*. The filaments are flattened, long, and triangular, and nearly petaloid in *H. congesta* and *cuneata*, but filiform, as in the true Potentils (a character said to be proper to *Ivesia*), in *H. Gordoni* and *tridentata*.[1] The floral receptacle rises into a higher tube in *H. congesta* than in most Potentils; but in most of the other species it is more spreading; in others, again, it is contracted below; in short, its form is by no means constant in the species which resemble each other most closely in all other respects. In nearly all the *Horkelias* the carpels are as numerous as in the true Potentils, while in *Ivesia* their number is usually as much reduced as in *Sibbaldia*, most of the species having only four or five; and some, such as *H. Gordoni*, may only have two, or even only one. This latter number is constant in the very remarkable plant named *I. santolinoides*,[2] which has fifteen stamens with didymous anthers, a hemispherical receptacle, and a hairy disk at the insertion of the stamens, while the flowers are arranged in cymes with slender axes, like those of a small Caryophyllad, and the leaves are very peculiar, as we shall see below. We have made it the type of a distinct section under the name of *Stellariopsis*. Its style is articulated at the base; it is at first terminal, and then becomes inserted on the internal angle of the ovary below the summit. Its insertion, and the presence of the articulation at its base are also variable in the different *Horkelias* and *Ivesias* above enumerated. All these plants[3] are herbs, possessing alternate stipulate pinnate leaves, with lobed leaflets. All have cymose flowers borne on a common scape. The foliage sometimes recalls that of *Potentilla* or *Geum*, sometimes that of *Spiræa* or *Sanguisorba*. The leaves of *I. santolinoides* appear at first sight to differ widely from these forms. They are little silky cylinders, which at a distance appear of a

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[1] Accordingly ASA GRAY, who considered *H. Gordoni* as a doubtful species of this genus, because of the form of its filaments, had placed this plant in the genus *Ivesia* (*loc. cit.*, 530).

[2] It is probably to this plant that BENTHAM & HOOKER allude in their *Genera* when they cite as intermediate between *Horkelia, Ivesia,* and *Potentilla*, a Californian species, with silky leaflets pressed together to form a cylindrical blade.

[3] A dozen species have been as yet described, all natives of North America, especially the Western regions—California, the Rocky Mountains, &c.

single piece; but they are really made up of numerous little leaflets crowded together, and as it were piled up on one another, being kept in contact by the velvety down with which they are covered.

Those *Ivesias* which, like *I. lycopodioides*,[1] have only five stamens are in that respect analogous to *Sibbaldia*[2] (figs. 423–427), which

Potentilla (Sibbaldia) procumbens.

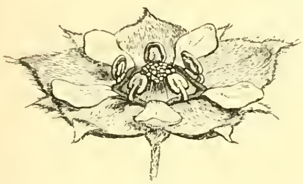

FIG. 423.
Flower.

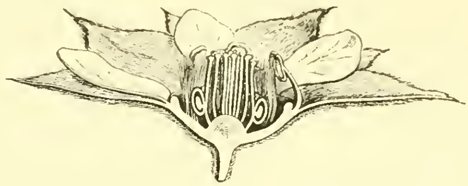

FIG. 424.
Longitudinal section of flower.

FIG. 426.
Carpel.

FIG. 425.
Multiple fruit.

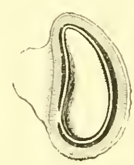

FIG. 427.
Longitudinal section of carpel.

comprises small plants from the temperate regions of Europe and Asia, and the arctic regions of America, possessing the androceum of *Potentilla pentandra*, with the habit, foliage, and floral organization[3] of very many alpine species of *Potentilla*, from which it is impossible to separate them. Nor is *Dryadanthe*[4] more distinct; it is a species

[1] A. GRAY, *Proc. Amer. Acad.*, *loc. cit.*, 531, n. 4.

[2] L., *Gen.*, n. 393.—J., *Gen.*, 337.—GÆRTN., *Fruct.*, i. 348, t. 73.—DC., *Prodr.*, ii. 586.—BUNG., *Ledeb. Fl. Alt.*, i. 428 —LEDEB., *Icon. Fl. Ross.*, t. 276.—ENDL., *Gen.*, n. 6367.—BOYLE, *Illustr. Himal.*, t. 40, fig. 5.—JACQUEM., *Voy. Bot.*, t. 67.—WALP., *Rep.*, ii. 37; *Ann.*, i. 269.

[3] The androceum may consist of ten stamens, but it is usually isostemonous. Thus in the flowers of *S. cuneata* KZE., there are only five stamens, alternipetalous, with introrse anthers, and filaments inserted round the edge of a glandular disk lining the porringer-like receptacle. This disk has five cusps, where the petals, articulated at the base, are inserted; while the stamens are inserted at the middle points of the concave edges. The filament, too, is articulated with the anther. The surface of the disk is covered with hairs between the stamens and the gynæceum. The number of carpels may be much reduced in *Sibbaldia*, but is here indefinite. The summit of the receptacle rises into a slender foot, dilated into a swelling at the apex where it bears the carpels, each with a little cylindrical stalk, a nearly gynobasic style and an ovule with a single coat, whose micropyle looks upwards and outwards.

[4] ENDL., *Gen.*, n. 6366.—*Sibbaldia tetrandra* BGE., *Verz. Alt. Pflanz.*, 25.

from the Altai and the Himalayas, whose flowers are polygamous, but in other respects altogether those of *Sibbaldia*.

In the above reduced types which we have referred to the genus *Potentilla*, when the androceum is only isostemonous, the persisting stamens are those superposed to the sepals. In the plants of which the genus *Chamærhodos*[1] has been made, the five oppositipetalous stamens alone persist.[2] The number of carpels varies; the ovule is always that of *Potentilla*, and the style is inserted at a variable height on the internal angle. The inflorescence is often, as in *Stellariopsis*, analogous to that of the *Caryophyllaceæ*, and the *bracteolæ* forming the calycle are absent or reduced to very rudimentary glands, as we shall find is the case in certain species of *Geum*. Thus, *Chamærhodos* is no more separable from the genus *Potentilla* than *Sibbaldia*, *Ivesia*, &c., and forms only a section apart. This is represented by four or five herbaceous plants, with the stem frutescent at the base, and with alternate leaves like those of the Tormentil; they are found in the centre and north of Asia, and also in America on the Rocky Mountains.

Thus constituted, the genus *Potentilla*, with its eleven sections,[3] includes about two hundred and fifty species, according to most descriptive works; but this number should be reduced by at least a third.

The Brambles[4] (Fr., *Ronces*—figs. 428–431) may be very briefly defined now that we know the two preceding genera. Their flowers are those of the Strawberries and Potentils, but have no calycle; and their fruits consist of a variable number of drupes, not achenes, inserted on the convex surface of a receptacle which is less fleshy than in

[1] BGE., *Ledeb. Fl. Alt.*, i. 429.—LEDEB., *Icon. Fl. Ross.*, t. 257, 271.—ENDL., *Gen.*, n. 6365.—TORR. & GR., *Fl. Bor.-Amer.*, i. 433. —WALP., *Rep.*, ii. 37, 913.—B. H., *Gen.*, 621, n. 49.

[2] Each consists of a rather slender filament and an introrse two-celled anther. On the inner face these cells are only separated from another by a shallow groove; the lines of dehiscence form two arcs with their concavities facing, and finally almost touch at both ends, marking out a sort of flap, the form of which might at first sight give the impression that the anther was unilocular.

[3] *Potentilla*.

Sections 11.
1. *Potentillastrum* (SER.).
2. *Tormentilla*.
3. *Comarum*.
4. *Fragariastrum*.
5. *Trichothalamus*.
6. *Sibbaldia*.
7. *Dryadanthe*.
8. *Horkelia*.
9. *Ivesia*.
10. *Stellariopsis*.
11. *Chamærhodos*.

[4] *Rubus* L., *Gen.*, n. 632.—ADANS., *Fam. des Pl.*, ii. 294.—J., *Gen.*, 338.—GÆRTN., *Fruct.*, i. 350, t. 73.—LAMK., *Dict.*, vi. 235; Suppl., iv. 693; *Ill.*, t. 441, fig. 1.—DC., *Prodr.*, ii. 556.—SPACH, *Suit. à Buffon*, i. 453.—ENDL., *Gen.*, n. 6360.—PAYER, *Organog.*, 503, t. ci. figs. 1–12. —B. H., *Gen.*, 616, n. 36.—? *Cylactis* RAF., *Sillim. Journ.* (1819), 377 (ex ENDL.).

the Strawberries. This central portion of the receptacle is generally conical and very prominent in the flower. The broad part on whose edges are inserted the perianth and androceum is like a shallow porringer, and is lined by a layer of glandular tissue. The carpels[1] and stamens[2] are indefinite in number; the sepals and petals

Rubus fruticosus (*Blackberry*).

Fig. 428.
Floriferous branch.

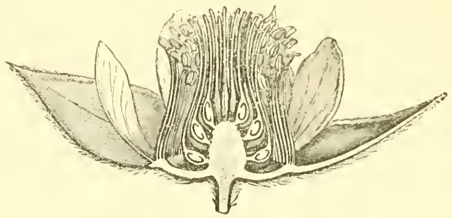

Fig. 429.
Longitudinal section of flower.

Fig. 430.
Fruits.

are imbricated in the bud, the former quincuncially.[3] Five hundred species have been described in this genus; but most of these are

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[1] They are usually very numerous in the species of *Rubus* proper. In the flower each consists of a one-celled ovary surmounted by a style which is terminal or inserted near the summit of the ventral angle of the ovary, stigmatiferous, and often more or less dilated at the tip. Owing to the insertion of the style the ovules, which are inserted at the same part, are exactly descending and completely anatropous, with the micropyle turned upwards and outwards. They have only a single coat, as in the Roses, whose floral organization is, except as regards the receptacle, altogether that of the Brambles. The two ovules are at first equal and collateral; but we rarely see both reach their full development; usually one of them is early reduced to a cellular mass, which may simulate an obturator and cap the exostome of the fertile ovule.

[2] The position of the stamens is, according to Payer, the same as in the Roses. At a certain stage we see the androeceum represented by only ten stamens placed in pairs, one stamen on either side of each petal (*loc. cit.*, fig. 3). Afterwards the other stamens arise in the intervals between these in verticils from without inwards. The first stamens appear on a sort of circular pad lining the edge of the inside of the receptacular cup.

[3] They early cease to overlap, and appear valvate in certain species. The flowers may be exceptionally tetra- or hexamerous.

contested, and considered as mere forms or varieties by certain authors, who only admit about one hundred true species. They are found in the warm and temperate regions of all five quarters of the globe.[1] Nothing can be more variable than their vegetative organs. In our country they are sarmentose shrubs, prickly, glabrous, tomentose, glandular, or covered with a whitish waxy dust. Elsewhere they are little perennial prostrate creeping herbs. This is the case with *Dalibarda*,[2] consisting of plants from America and Asia, which only differ from the true Brambles in the thinner fleshy portion of their pericarp. The number of carpels is, it is true, sometimes smaller and nearly definite; but this peculiarity is also found in several of the true *Rubi*. The leaves of the Brambles are often lobed, or compound with three or five leaflets, or even imparipinnate with indefinite leaflets; they sometimes resemble those of the Rose, sometimes those of *Geum*, *Fragaria*, or *Spiræa;* more rarely they are simple, as in the Pear or the Plum. They always possess two lateral petiolary stipules. The flowers are rarely solitary; they are usually cymose, axillary or terminal, often collected near the tops of the branches into simple or ramified cymes described as panicles or thyrses. In this case the leaves to which the cymes are axillary become gradually smaller and simpler, and are finally reduced to narrow bracts.

Rubus idæus (*Raspberry*).

Fig. 431.
Fruit.

[1] Thunb., *De* Rubo, 1813.—Rudb., Rub. humn., 1716.—Paull., *De* Chamæm. Norv., 1676.—Camer., *De* Rub., id., 1721.—Schulz., *De* Rub. id., 1744.—Arrhen., *Mon.* Rub. *Suec.*, 1840.—Nees & Weihe, Rub. *German.*, 1820.—Waldst. & Kitaib., *Pl. Hungar. Rar.*, t. 141, 268.—Gren., *Mon. des* Rub. *des Envir. de Nancy*, 1843.—Gren. & Godr., *Fl. de Fr.*, i. 536.—Chaboiss., *Bull. Soc. Bot. de Fr.* vii. 268.—Babingt., *Syn. of Brit.* Rub., 1840, Suppl., 1850; *The British Rubi*, 1867.—Jacq., *Voy.*, t. 59, 60.—H. B. K., *Nov. Gen. et Spec.*, vi. 172, t. 557, 558.—Torr. & Gr., *Pl. N. Amer.*, i. 449.—A. Gray, *Man. of Bot.*, ed. v. 156.—Chapm., *Fl. S. Unit.-States*, 124.—Torr. & Gr., ap. Wippl. 164.—Wedd., *Chlor. And.*, ii. 231.—C. Gay, *Fl. Chil.*, ii. 307.—Hook. F., *Fl. Antarct.*, p. ii. 263; *Handb. of the N.-Zeal. Fl.*, 54.—Seem., *Herald*, 282, 376.—Benth., *Fl. Austral.*, ii. 429; *Fl. Hongk.* 104.—Roxb., *Fl. Ind.*, ii. 516.—Miq., *Fl. Ind.-Bat.*, i. p. i. 373; *Mus. Lugd. Bat.*, iii. 34.—Wight, *Icon.*, t. 225, 231, 232.—Thwait., *Enum. Pl. Zeyl.*, 101.—Harv. & Sond., *Fl. Cap.*, ii. 286.—Hook., *Icon.*, t. 46, 349, 729, 730, 741, 742. Lindl., *Bot. Reg.*, t. 1368, 1424, 1607.—Walp., *Rep.*, ii. 13, 912; v. 649; *Ann.*, i. 972; ii. 467; iii. 855; iv. 657.

[2] L., *Spec.*, ed. 1, 431.—Michx., *Fl. Bor.-Am.*, i. 299, t. 27.—Lamk., *Dict.*, vi. 249; Suppl., iv. 696; *Ill.*, t. 441, fig. 3.—Nestl., *Pot.*, 16, t. 1.—DC., *Prodr.*, ii. 563.—Torr. & Gr., *Fl. N. Amer.*, i. 449.—Endl., *Gen.*, n. 6359.—The carpels are sometimes very numerous in these plants. They are said to become achenes; but we have seen that in several species, they become nearly as fleshy when ripe as in our indigenous Brambles.

Geum,[1] (Eng., *Avens*; Fr., *Benoîte*—figs. 432–434) has altogether the flower of *Potentilla*, the same receptacle, the same calycle, the same valvate calyx, and the same organization of the corolla, the androceum, the disk, and the outer parts; but the

Geum urbanum (*Herb Bennet*).

FIG. 432.
Branch.

ovary of each carpel contains one erect basilar ovule, while that of the Potentils is descending; yet strange to say, the micropyle of this ovule, though inferior, still looks outwards[2] (fig. 435). In *Geum* proper the style is inserted at or very near the apex of the ovary, and is once or twice bent on itself before terminating in a stigmatiferous

[1] *Geum* L., *Gen.*, n. 636.—J., *Gen.*, 338.—GÆRTN., *Fruct.*, i. 351, t. 74.—LAMK., *Dict.*, i. 398; Suppl., i. 615; *Ill.*, t. 443.—DC., *Prodr.*, ii. 550.—SPACH, *Suit. à Buffon*, i. 479.—ENDL., *Gen.*, n. 6386.—PAYER, *Organog.*, 501, t. c. figs. 1–22.—B. H., *Gen.*, 619, n. 44.—*Caryophyllata* T., *Inst.*, 294, t. 151.—ADANS., *Fam. des Pl.*, ii. 295.—MŒNCH, *Meth.*, 661.

[2] It has only one coat, and is at first descending while it still consists of only a naked nucleus. Pretty frequently it so happens that we find two ovules in the ovary, of which one alone is fertile and well developed.

head, and is glabrous or nearly so; while in *Sieversia*,[1] wrongly made into a distinct genus, it is straight, and elongates into a slender rod, covered with long hairs after fertilization. The multiple fruit consists of numerous achenes, surmounted by the persistent styles, and borne on a common more or less elongated column, representing the top of the floral axis. In each achene is an erect seed, whose membranous coats inclose an exalbuminous embryo, with its radicle inferior. *Geum* consists of perennial herbs, whose growth recalls the Strawberries and Potentils. Their leaves possess two lateral petiolary stipules and are imparipinnate, or pinnatisect towards the base of the stem. The flowers are solitary, or clustered in often few-flowered cymes on a common peduncle.

The Siberian plant that has been designated *Coluria*[2] is only a *Geum*, whose styles are articulated at the base and fall off the achenes in the fruit.[3] *Waldsteinia*[4] (figs. 433, 434) presents the same peculiarity, and has, moreover, the flowers of *Coluria*, but the number of carpels is reduced; there are often only five or six, and one species[5] cultivated in our gardens has usually only two or

[1] W., *Berl. Mag.*, v. 398.—R. Br., *Parr. First Voy.*, App., 286, t. c.—Cham. & Schltl., *Linnæa*, ii. 4.—Endl., *Gen.*, n. 6384.—*Buchavea* Reich., *Conspect.*, 167.—*Adamsia* Fisch., ex Endl., *loc. cit.*—*Oreogeum* Ser., DC., *Prodr.*, ii. 553.

[2] R. Br., *Parr. First Voy.*, App., 276, not.—Bge., *Ledeb. Fl. Alt.*, ii. 262.—Endl., *Gen.*, n. 6388.—B. H., *Gen.*, 619, n. 46.—*Laxmannia* Fisch., ex Ledeb., *loc. cit.*—*Geum Laxmanni* Gærtn., *Fruct.*, i. 132, t. 74.—DC., *Prodr.*, ii. 554, n. 28 (sect. *Stictogeum* Ser.).—*G. potentilloides* Ait., *Hort. Kew.*, ed. 1, v. 2, 219.—*Dryas geoides* Pall., *It.*, iii. 372, t. v. fig. 1, B, C.

[3] The base of the carpels is also articulated with the receptacle. In the cultivated plant there are sometimes two equally developed ovules in each carpel, even at maturity.

[4] W., *N. Verh. Berl. Natur. Freund.*, ii. 106, t. 4, fig. 1; *Spec.*, ii. 1007.—Waldst. & Kit., *Plant. Hungar. Rar.*, t. 77.—Nestl., *Pot.*, 17, t. i.—DC., *Prodr.*, ii. 555.—Spach, *Suit. à Buffon*, i. 481.—Endl., *Gen.*, n. 6382.—B. H., *Gen.*, 619, n. 45.—*Comaropsis* L. C. Rich., Nestl., *Pot.*, 16, t. 1.—DC., *Prodr.*, ii. 555.—Endl., *Gen.*, n. 6383 (ex part.).

[5] *W. Geoides* W., *loc. cit.* — Lodd., *Bot. Cab.*, t. 492.—*Bot. Mag.*, t. 2595. It is a perennial herb, whose rhizome is covered with alternate leaves or their scars, and with adventitious roots. In the spring this rhizome elongates by its superior extremity, which gradually rises vertically. This part bears new leaves, dilated and sheathing at the base of the petiole, but without true stipules. Axillary to these are leafy branches or inflorescences. The floriferous branches bear first some leaves, which here possess distinct stipules, and then alternate bracts. A single flower of the first generation terminates the axis; then arises from the axil of each of the bracts below it a secondary axis, also terminated by a flower, and itself bearing an axis of the third order. Thus the inflorescence is analogous to that of *Geum* proper, a terminal panicle of alternate uniparous few-flowered cymes. In the flower we have a calycle whose leaves may be deduplicated, a valvate calyx, and an imbricated corolla. The petals have at the base a little glandular nectary bounded internally by a scale very much like that on the petals of several Crowfoots. There are from thirty to forty stamens. In the former case five are superposed to the sepals, and the rest are in five groups of five each in front of the petals. The interior of the receptacle is lined by a glandular disk, first of all forming a festoon projecting to the foot of each of the innermost petals, and then becoming thinner and extending to above the insertion of the corolla. The bottom of the receptacle rises up into a slender column as in *Geum*; but instead of being smooth or pitted, it divides at the apex into two

three. From *Geum*, however, we cannot separate *Coluria*, because of its articulated style, nor *Waldsteinia* on account of the reduced number of its carpels, since we do not distinguish *Horkelia* or *Sibbaldia* and *Ivesia* respectively, presenting as they do these characters, from

Geum Waldsteinia.

FIG. 433.
Flower.

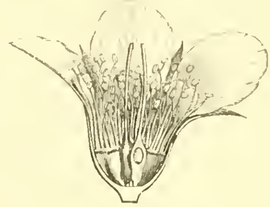

FIG. 434.
Longitudinal section of flower.

Potentilla. In this genus *Geum* we must also retain *Stylipus vernus*,[1] a small-flowered North American plant, in which the calycle disappears entirely, or is only represented by five very minute glands alternating with the sepals. The same thing occurs in some of the known species[2] of the section *Waldsteinia*. Thus marked out, the genus *Geum* includes about thirty-five species,[3] from the cold and temperate regions of all parts of the world, but more abundant in the northern hemisphere.

The genus *Dryas*[4] (fig. 435), which has often given the group now under consideration the tribal name of *Dryadeæ*,[5] has altogether the sexual organs[6] and fruit of the section *Sieversia* of *Geum*; but the

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or three branches, as many as there are carpels. Each ovary is articulated with the top of this branch and the style itself is articulated at its base, as in *Coluria*. The ovule is that of *Geum* proper.

[1] RAFIN., *Neogen.* (1825), 3, ex TORR. & GR., *Fl. N. Amer.*, i. 422.—*Geum vernum* TORR. & GR., *loc. cit.*

[2] DC., *loc. cit.*—TORR. & GR., *Fl. N. Amer.*, i. 426.—A. GRAY, *Man. of Bot.*, ed. v. 153.—CHAPM., *Fl. S. Unit.-States*, 123. — WALP., *Rep.*, ii. 46.—HOOK., *Icon.*, t. 76; *Bot. Mag.*, t. 1567, 2595.

[3] DC., *Prodr.*, ii. 550, 555.—GREN. & GODR., *Fl. de Fr.*, i. 519.—BOISS., *Voy. Esp.*, t. 58.—TORR. & GR., *Fl. N. Amer.*, i. 420.—A. GRAY, *Man. of Bot.*, ed. v. 151; *Pl. Fendler.*, 40.—CHAPM., *Fl. S. Unit.-States*, 123.—C. GAY, *Fl. Chil.*, ii. 276.—WEDD., *Chlor. And.*, ii. 235.—HOOK. F., *Fl. Antarct.*, ii. 262; *Handb. of N.-Zeal. Fl.*, 55.—BENTH., *Fl. Austral.*, ii. 427.—HARV., *Thes. Cap.*, t. 18.—HARV. & SOND., *Fl. Cap.*, ii. 289.—WALP., *Rep.*, ii. 46; v. 656; *Ann.*, i. 972.—*Bot. Reg.*, t. 1088, 1318.

[4] L., *Gen.*, n. 637.—J., *Gen.*, 338.—GÆRTN., *Fruct.*, i. 352, t. 74.—LAMK., *Dict.*, ii. 329; Suppl., ii. 525; *Ill.*, t. 443. — NESTL., *Pot.*, 16.—DC., *Prodr.*, ii. 549. — SPACH, *Suit. à Buffon*, i. 477.—ENDL., *Gen.*, n. 6389.—B. H., *Gen.*, 618, n. 42.—*Chamædrys* CLUS., *Hist.*, ii. 351, ex ADANS., *Fam. des Pl.*, ii. 295.

[5] VENTL., *Tabl.*, iii. 349.—ENDL., *op. cit.*, 1241.—*Eudryadeæ* TORR. & GR., *Fl. N. Amer.*, i. 426.

[6] *D. octopetala* L. (*Spec.*, 717) has very numerous stamens, as in most species of *Geum*. The filaments, inflexed in the bud, are inserted on the margin of the glandular coloured disk lining the receptacle. The carpels are very numerous, and like those of *Sieversia* (fig. 435). The

calyx and corolla consist of eight or nine leaves apiece; the achenes are sessile, and the solitary flowers are borne on erect terminal peduncles. Only two species are known, from arctic, alpine and temperate districts of the northern hemisphere;[1] they are undershrubs, with pretty thick stems, which rise to no great height, but are usually prostrate and ramified, bearing short branches with alternate, simple, very polymorphous leaves, possessing two lateral petiolary stipules.

Dryas octopetala.

FIG. 435. Carpel opened.

Cowania and *Fallugia* have also the sessile achenes surmounted by long feathery styles of *Dryas* or *Sieversia;* but have quite different vegetative organs. They are true erect very bushy shrubs, found in North America, Mexico, and California. *Cowania*,[2] of which three species have been described, has hermaphrodite or polygamous flowers with the receptacle of *Rosa*, covered externally, like the calyx, with capitate glandular hairs; five unequal quincuncially imbricated sepals, and five imbricated petals alternating with these; and a large number of stamens inserted in the throat of the receptacle, above the thick edge of a glandular disk lining the inside of the sac. The carpels are five in number, or more frequently indefinite, inserted in the bottom of the receptacular sac, and each containing an erect ovule. Each fruit contains a seed with a fleshy embryo, surrounded by a thin layer of albumen. The flowers are solitary and sessile, terminating the short branches which are covered by numerous alternate leaves, each of which possesses two lateral petiolary stipules entire, or more or less deeply notched or lobed. *Fallugia*,[3] of which only one species is known, has the calyx of *Cowania*,

ovary contains one ovule which is incompletely anatropous, so that its hilum is higher up than its micropyle; it has only one coat. The stigmatiferous extremity of the style is scarcely dilated.

[1] HOOK., *Exot. Flor.*, t. 220; *Bot. Mag.*, t. 2972.—GREN. & GODR., *Fl. de Fr.*, i. 518.—WALP., *Rep.*, ii. 49; *Ann.*, i. 286.

[2] DON, *Trans. Linn. Soc.*, xiv. 574, t. 22, figs. 1–6.—ENDL., *Gen.*, n. 6387.—SWEET, *Brit. Fl. Gard.*, ser. 2, vii. t. 400.—TORR. & GR., ap. *Wippl. Exped.*, 164 (28).—B. H., *Gen.*, 618, n. 41.—*Greggia* ENGELM., *Bot. Wisliz. Exped.*, 30, not.

[3] ENDL., *Gen.*, n. 6385.—TORR., *Emor. Rep.*, t. 2.—TORR. & GR., ap. *Wippl. Exped.*, 164 (28).—H. B., *Gen.*, 618, n. 43.—*Sieversia paradoxa* DON, *Trans. Linn. Soc.*, xiv. 576, t. 22, fig. 7–10.

but with a calycle; the ovary and androceum are identical, the disk is covered with hairs, and the carpels are seated on a central prominence of the receptacle. The leaves are irregularly lobed or pinnatifid, and the flowers are borne on long slender peduncles; these are sometimes solitary, sometimes accompanied by lateral younger flowers, also borne on long axes, on which we find but a few scattered bracts. Thus the two genera *Cowania* and *Fallugia* are only separated by characters of very little value.[1]

Chamæbatia[2] may be considered as *Geum* or *Cowania* with a unicarpellary gynæceum. The floral receptacle forms a pretty deep cup, lined by a thin downy disk and covered externally with capitate glandular hairs. On its rim are inserted five valvate sepals, and five alternating petals, imbricated in the bud. The stamens are indefinite, inserted within the perianth,[3] with free filaments inflexed in the bud, and introrse two-celled anthers. The flower is, then, also nearly that of the Brambles; but the gynæceum only consists of one nearly central carpel. The unilocular ovary is swollen on one side, and is traversed on the opposite side by a vertical groove,[4] continued the whole length of the terminal style surmounting the ovary. The thick edges of this groove are everted for nearly the whole length of the style, and are covered with stigmatic tissue. At the base of the ovary is a short placenta bearing a single erect anatropous ovule, whose raphe looks towards the above-mentioned groove, while the micropyle is inferior and dorsal as in *Geum*. The fruit is an achene with a coriaceous pericarp, surrounded by the receptacular sac. The seed is ascending, and attached by a broad umbilicus; it contains within its thick spongy coats a fleshy embryo, with its radicle inferior, and surrounded by a thin layer of albumen. The only known species of this genus[5] is a little shrub with odoriferous organs covered with glandular hairs. The leaves are alter-

[1] And, were it not for the consistency of their stems, no one would have dreamed of separating them from *Geum*, towards which *Dryas* already afforded a passage, so to say, with its thick rhizome and its smaller and simpler leaves. It would be no more strange to recognise the species of *Cowania* and *Fallugia* as belonging to the genus *Geum*, than to consider *Potentilla fruticosa* and the allied woody species as members of *Potentilla*.

[2] BENTH., *Plant. Hartweg.*, 308.—B. H., *Gen.*, 617, n. 39.

[3] They are shorter and inserted lower down the receptacular cup as they are more internal.

[4] In the fresh flower I have seen that the lips of this groove are in contact but without any cohesion; so that they may be separated without any breach of tissue.

[5] *C. foliolosa* BENTH., *loc. cit.*—HOOK., *Bot. Mag.*, t. 5171.—HER., *Hortic. Franç.* (1861), t. ii.—TORR., *Plant. Fremont.*, t. vi.—TORR. & GR., ap. *Wippl. Exped.*, 164 (28).

nate, stipulate, glandular, tripinnatisect, with very numerous pinnules, glandular at their apices. The flowers, accompanied by glandular bracts, are collected into little cymes terminating the branches.

Purshia[1] in habit and foliage nearly resembles *Cowania*, and not certain species of *Potentillas* as is the case with *Chamæbatia* ; still the flowers are very like those of the last-named genus: the same perianth, the same external capitate hairs, the same gynæceum, with its peculiar stigma formed of papillæ scattered over the everted lips of the longitudinal groove of the style, the same ovule with its ventral raphe and its interior dorsal micropyle. The sepals and petals are imbricated in the bud, and the dry fruit, partly surrounded by the hardened receptacle, contains a single seed with thin albumen and an erect embryo whose radicle is inferior.[2] But the androceum of *Purshia* contains a far lower number of stamens; there are usually only from twenty to thirty; the receptacle on whose edges they are seated is much more elongated, like a cornet or a narrow funnel; and the alternate leaves are small, serrate, simple, and cuneiform, or tridentate, trifid, or even pinnatifid, with two little adnate stipules at the base of the petiole. The only known species,[3] which grows in the Rocky Mountains, has the appearance of a little much-branched *Cotoneaster*. Its flowers are sessile, axillary and terminal.

Cercocarpus[4] (figs. 436, 437) also consists of shrubs or undershrubs, in habit and foliage recalling certain species of *Cowania*. The hermaphrodite flowers are constructed on the same general type as in the two preceding genera ; the gynæceum, too, is reduced to a single carpel whose ovary contains a single nearly basilar ovule, with its raphe ventral. But there are no petals, and the receptacle presents considerable modifications in the conformation of its different parts. It is like a narrow vase, much elongated, and

[1] DC., *Trans. Linn. Soc.*, xii. 157 ; *Prodr.*, ii. 541.—HOOK., *Fl. Bor.-Amer.*, i. 170, t. 58.—LINDL., *Bot. Reg.*, t. 1446.—ENDL., *Gen.*, n. 6380.—TORR. & GR., *Fl. N. Amer.*, i. 428.—B. H., *Gen.*, 617, n. 37.—*Tigarea* PURSH., *Fl. N. Amer.*, i. 333, t. 15 (nec AUBL.).—*Kunzia* SPRENG., *Syst. Veg.*, ii. 475 (nec REICH.).

[2] The testa is thick, blackish, and shining, and almost spongy internally. BENTHAM & HOOKER remark that this organization, which is exceptional in the *Fragarieæ*, would seem to bring *Purshia* near certain *Spireeæ*.

[3] *P. tridentata* DC., *loc. cit.*—*Tigarea tridentata* PURSH.

[4] H. B. K., *Nov. Gen. et Spec.*, vi. 183, t. 559.—DC., *Prodr.*, ii. 589 —TORR. & GR., *Fl. N. Amer.*, i. 427.—HOOK., *Icon.*, t. 322-324.—ENDL., *Gen.*, n. 6381.—B. H., *Gen.*, 618, n. 40.—*Bertolonia* SESS. & MOÇ., ex DC., *loc. cit.* (nec SPRENG., nec RADD.).

gradually tapering into a long linear neck, which near the mouth suddenly expands into a broad cupule, on whose edges are seated the sepals and stamens. Of the former there are five or six, at first imbricated in the bud.[1] The latter are from fifteen to thirty in number, arranged in verticils, each stamen composed of a free filament and an introrse two-celled anther dehiscing longitudinally. The receptacular cupule is lined by a very thin layer of glandular tissue. In the very bottom of the receptacle is inserted the gynæceum, whose free ovary tapers above into a slender style, which passes out of the narrow mouth of the receptacle to end in a slight stigmatiferous dilatation. After fertilization the gynæceum goes on enlarging, and the style goes on elongating, and then lifts up and carries with it the upper part of the receptacle which comes off (fig. 436) from the lower part near the base of the neck, and leaves it persisting like a narrow flask around the fruit. This is a coriaceous achene with an elongated seed, whose straight embryo has its radicle inferior. The persistent style forms a long feathery column, owing to the great development of the hairs which covered it. Of this genus five or six species are known, trees or shrubs from California and Mexico,[2] with simple, alternate, thick, petiolate leaves, possessing an entire or dentate blade, with prominent, oblique, parallel ribs, so as often to recall those of the Hornbeam or Alder; their petioles have two

Cercocarpus fothergilloides.

FIG. 436. Flower after rupture of the receptacle.

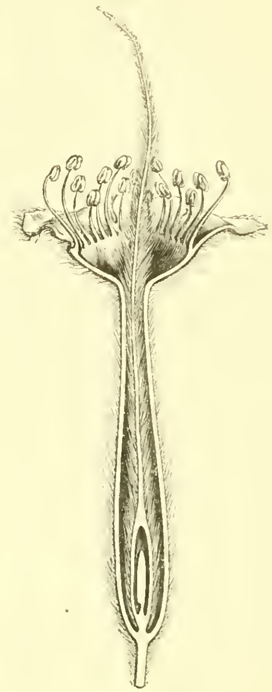

FIG. 437. Longitudinal section of flower.

[1] They early become valvate, and finally their edges cease to touch.

[2] TORR. & GR., *Fl.*, *loc. cit.*; *Wippl. Exp. Bot.*, 164.—WALP., *Rep.*, ii. 45; *Ann.*, iv. 665.

lateral adnate stipules. The flowers are axillary or terminal, sessile or shortly pedicellate, solitary or collected into short spikes of cymes.

With a habit and leaves analogous to those of several plants of the genera we have just studied, *Coleogyne*[1] has the characters of *Potentilla* in the structure of its gynæceum and the direction of its ovule; so that we may say that it is to the latter genus what *Chamæbatia*, *Purshia*, and *Cercocarpus* are to *Geum*. Its hermaphrodite flowers have a tubular receptacle lined by a glandular tissue covered with hairs. On the rim of the tube is inserted a calyx of five unequal imbricated leaves.[2] The androceum consists of an indefinite number of stamens, whose filaments are inserted, not only on the receptacular cup,[3] but also on the sheath surrounding the gynæceum; the introrse two-celled anthers dehisce longitudinally. The unilocular ovary is inserted, as in *Purshia*, in the bottom of the receptacle; and about half-way up its ventral angle[4] arises a tortuous style, more or less bent on itself near the base. Along the ventral edge of the ovary and the whole length of the style, is a vertical groove; the edges of its stylar portion are thickened and everted, and covered with stigmatic papillæ. Attached to the wall of the ovary, on a level with the insertion of the style, is a descending, incompletely anatropous ovule, whose micropyle looks upwards and outwards, so that in the seed, which is as yet unknown, the radicle must be superior. Around and above the ovary the disk is prolonged, nearly as in *Rhodotypus* (p. 381), into a sort of sheath, whose finely laciniate or ciliate mouth[5] gives passage to the upper part of the style.[6] The only known species of this genus[7] is a Californian shrub,[8] possessing little alternate simple appressed petiolate hairy leaves,[9] with two lateral adnate stipules. The flowers are solitary terminal, with a few lobed imbricated bracts at the base.

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[1] Torr., *Plant. Fremont.*, 8, t. iv.—B. H., *Gen.*, 617, n. 38.

[2] This calyx is the same as in *Purshia*. When it has only four petals their prefloration is alternative-imbricate.

[3] Towards its lower part, but still certainly perigynous.

[4] The style is inserted here, and after first descending a little way in the bud, rises up and becomes vertical. The surface of the ovary is somewhat uneven and tuberculated, and above the insertion of the style, as in *Adenostoma*.

[5] The tissue of this opening is papillose, like a stigmatic surface. Several stamens are inserted as above stated towards the base of the outer surface of the sheath. Its inner surface is covered with long erect hairs.

[6] This also presents a longitudinal ventral groove, whose thickened everted lips bear stigmatic papillæ.

[7] *C. ramosissima* Torr., *loc. cit.*—Walp., *Ann.*, iv. 641.

[8] "*Frutex habitu* Krameriæ" (Torr.). The habit is also near that of *Purshia* and some of the smaller *Amygdaleæ*, such as *Emplectocladus*. Here and there the branches end in spines.

[9] Some of these are what are called *Malpighiaceous*.

At the end of this series we put a genus which, though hitherto referred to *Spiræa*, appears to us in all important characters closely analogous to *Purshia* and *Coleogyne*. The flowers of *Adenostoma*[1] (fig. 438) are small and hermaphrodite; the receptacle is like an elongated cornet, traversed externally by prominent vertical ribs, and lined by a layer of glandular tissue with a festooned thickened edge. On the borders of the mouth of the receptacle are inserted the perianth and androceum, while the gynæceum is inserted in the bottom of its cavity. There are five sepals, imbricated in the bud, as are the five petals. The stamens are from seven or eight to fifteen or twenty in number, arranged in whorls like those of so many other *Rosaceæ*, and each consisting of a free filament inflexed in the bud, and an introrse two-celled anther, whose connective is thickened, and which dehisces longitudinally. The gynæceum consists of a single free carpel, with a shortly stipitate one-celled ovary, containing one or two descending collateral anatropous ovules, whose micropyles are superior and dorsal, and which are inserted on a parietal placenta. The summit of the ovary is unequally gibbous,[2] and covered on one side with hairs; near it is inserted the style, which here first forms one bend and then ascends, finally terminating in a more or less oblique stigmatiferous dilatation. The fruit is an achene, surrounded by the hard persistent receptacle. Two species of *Adenostoma* are known, bushy shrubs of Heath-like habit[3] from California, with narrow coriaceous alternate leaves, solitary or fascicled, possessing two little lateral stipules. The flowers are collected into glomeruli in the axils of the leaves or the bracts which replace them towards the summit of the branch; so that the whole inflorescence forms a spike of glomeruli.

Adenostoma fasciculatum.

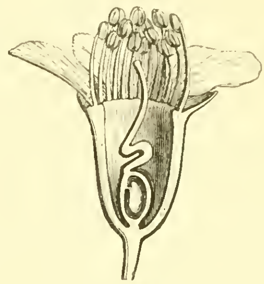

FIG. 438.
Longitudinal section of flower.

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[1] HOOK. & ARN., *Bot. Beech. Voy.*, 139, 338, t. 30.—ENDL., *Gen.*, n. 6371.—B. H., *Gen.*, 614, n. 26 (nec BL.).

[2] Especially in *A. fasciculata*. In *A. sparsifolia* it bears a nearly regular prominent ring near the insertion of the style; above this are chiefly inserted the hairs covering its summit and persisting on the fruit.

[3] WALP., *Rep.*, v. 655.—TORR., *Emor. Rep.*, 63, t. 20.—TORR. & GR., *Wippl. Rep.*, 164 (28).

IV. SPIRÆA SERIES.

Spiræa[1] (figs. 439–441) has regular polygamo-diœcious, or more frequently hermaphrodite flowers. In the woody species with perfect flowers, largely cultivated in our gardens, such as *S. lanceolata*,[2] we find a flattened cup-shaped receptacle, lined with glandular tissue,

Spiræa lanceolata.

FIG. 439.
Branch.

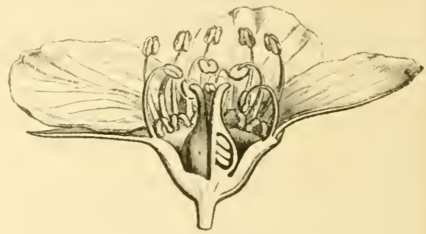

FIG. 440.
Longitudinal section of flower.

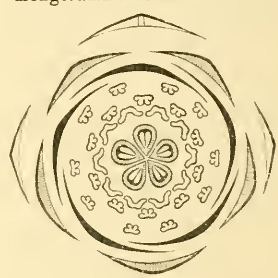

FIG. 441.
Diagram.

and bearing on its edges the perianth and androceum; while the gynæceum is inserted right at the bottom. The calyx consists of five valvate sepals, and the corolla of as many alternating sessile imbricated or contorted petals. The stamens are twenty in number, arranged in three whorls. Five are superposed to the sepals, five to

[1] *Spiræa* T., *Instit.*, 618, t. 389.—L., *Gen.*, n. 630.—ADANS., *Fam. des Pl.*, ii. 295.—J., *Gen.*, 339.—GÆRTN., *Fruct.*, i. 337, t. 69.—LAMK., *Dict.*, vii. 348; Suppl., v. 221; *Ill.*, t. 439.—CAMBESS., *Monogr. du G.* Spiræa, *Ann. Sc. Nat.*, sér. 1, i. 224, t. 15-17, 25-27.—SER., in DC., *Prodr.*, ii. 541.—SPACH, *Suit. à Buffon*, i. 430.—ENDL., *Gen.*, n. 6391.—PAYER, *Organog.*, 495, t. cii.—B. H., *Gen.*, 611, n. 18.—*Ulmaria* T., *op. cit.*, 265, t. 141.—*Filipendula* T., *op. cit.*, 293, t. 150.—*Barba Capræ* T., *op. cit.*, 265, t. 141.—*Eriogyna* HOOK., *Fl. Bor.-Amer.*, i. 255, t. 88.—*Luetkea* BONG., *Mem. Acad. S.-Petersb.*, vi. sér. ii. 130, t. 2.—ENDL., *Gen.*, n. 4636.

[2] POIR., *Dict.*, vii. 354, n. 15.—SER., *Prodr.*, n. 7.—*S. cantoniensis* LOUR., *Fl. Coch.*, 322 (ex CAMBESS., *loc. cit.*, 366, t. 25).—*S. Reevesi* LINDL.

the petals, and the other ten are placed one on either side of each of the latter set. Every stamen consists of a free filament, inflexed in the bud, and an introrse two-celled anther, dehiscing longitudinally.[1] The edge of the disk projects internally to the androceum into ten more or less prominent glandular lobes, two superposed to each sepal. The gynæceum consists of five carpels, each superposed to a petal (fig. 441), and composed of a free one-celled ovary tapering above into a style which is slightly dilated at the tip and covered with stigmatic papillæ. In the internal angle of the ovary is a longitudinal placenta with two lips, each bearing an indefinite number of horizontal or obliquely descending anatropous ovules.[2] The multiple fruit consists of five many-seeded follicles, surrounded by the persistent receptacle and calyx. The seed contains within its membranous coats a fleshy exalbuminous embryo. All the species of *Spiræa* analogous to the one just studied,[3] representing the most perfect types of the genus, possess alternate simple stipulate or exstipulate leaves, and corymbose flowers.[4] But of about fifty species of this genus there are many, which, with the general organization of those we know, present in several of the floral organs various modifications which it is now our duty to mention.

The flowers are sometimes tetramerous.[5] The form of the receptacle may vary somewhat; it may be pouched or bell-shaped, or it may form a shallow cupule; it is very rarely like a long tube or an inverted cone.[6] The æstivation of the sepals may be imbricate. There are pretty often as many as twenty-five or thirty stamens, and in some few cases more.[7] There are rarely less than fifteen.[8]

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[1] The pollen of several species of *Spiræa* has been described by H. MOHL (*Ann. Sc. Nat.*, sér. 2, iii. 340) as consisting of ovoidal papillate grains with three grooves; in water they are spherical, with three bands; the species were *S. Ulmaria*, *S. sorbifolia*, *S. oppositifolia*, and *S. Filipendula* (without papillæ).

[2] They have only a single coat in this species, as in several others that I have examined; it would be worth while to study all the cultivated *Spiræas* from this point of view.

[3] They form the two sections *Chamædryon* (SER., *op. cit.*, 542) and *Spiraria* (SER., *op. cit.*, 544), united by ENDLICHER (*loc. cit.*, b) into a single one.

[4] Or they may be in usually short racemes. In *S. lanceolata*, as in many other species, the pedicel does not appear to spring from the axil of a bract, for this is not found on the chief axis, below the insertion of the pedicel, but some way up the latter, which was at first axillary to it and has carried it up; sometimes the bract is even close against the base of the flower.

[5] Sometimes they have six sepals and six petals, or even more, as in *S. Filipendula*, which has often seven, eight, or nine petals.

[6] "*In* S. parvifolia BENTH., *specie admodum singulari, calycis tubus obconicus est, lobis exacte valvatis.*" (B. H., *Gen.*, 612.)

[7] Either because there are five in front of each petal (where we only found three in *S. lanceolata*), or because there are two or three in front of each sepal instead of only one.

[8] In *Eriogyna*, which we were the first (*Adansonia*, vi. 6) to place near *Spiræa*, the stamens have been said to cohere by the bases of their filaments. This is not constant, and is in

The disk lining the receptacle is sometimes thin and inconspicuous; again, the glands, into which, as we have seen, its edge is split, may become very prominent; they may be quite free or united in pairs. This disk usually stops abruptly below the insertion of the stamens; but in several herbaceous species the stamens are inserted, not only within its edges, but all over its surface, right down from the base of the perianth to near the insertion of the gynæceum.[1] The number and position of the carpels are very variable; they may be equal in number to the petals and superposed to them, as above; or double their number, half being superposed to the sepals.[2] But, strange to say, those in front of the petals may then disappear, leaving only those superposed to the sepals.[3] Finally, their number may be indefinite, or it may diminish to less than four or five, and even be reduced to one or two.[4] Rarely are the carpels not quite free from each other, and sometimes the organic apex of the receptacle will even rise up into a little cone and separate the ovaries.[5] But sometimes the latter are all united for a variable height, so that a transverse section of the lower part of the gynæceum will show a single several-celled ovary with axile placentation.[6] The ovules are not invariably indefinite, and horizontal or only slightly descending. There are sometimes only two, or even a single one,[7] descending and completely or nearly anatropous, with the micropyle upwards and outwards.

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any case so ill-marked that it is not worth while to take it into consideration. The floral bracts are here carried up very high on their axillary pedicels.

[1] Thus, in *S. lobata* the stamens are inserted as above, over the whole surface of the receptacular disk. In *S. Ulmaria*, VAUCHER has denied the existence of a disk, and supposed that the stamens were hypogynous. But they are inserted on the periphery of the receptacular sac, and there is a yellowish disk with its frilled edge just internal to their insertion. In *S. Filipendula* the stamens are placed at different heights on the inner surface of the receptacle. But the outermost are inserted a good way below the petals. The latter have articulated bases each seated just in the bottom of the sinus between two adjacent sepals. The shallow receptacle of *S. Aruncus* is lined by a glandular disk, whose edges are indistinctly lobed; but there are none of the prominent isolated or geminate marginal glands found in most of the other species. In *S. sorbifolia* the margins of the intra-receptacular glandular layer are nearly entire, as they often are in *Eriogyna*.

[2] There are as many as fifteen in *S. Filipendula*. *S. lobata* has often eight or nine carpels, with a tetramerous perianth.

[3] In *S. Lindleyana*, for instance, as pointed out by RŒPER. This also occurs in *S. sorbifolia*, the type of the section *Sorbaria* (SER., *loc. cit.*, 545), or *Schizonolus* (LINDL., *Wall. Cat.*, n. 703).

[4] As in *S. Aruncus*, the type of the section *Aruncus* (SER., *loc. cit.*, 545), which, however, has more frequently three or four; also in the allied species, which are most probably only forms of this. These plants have usually unisexual flowers.

[5] This is pretty well marked in *S. Filipendula*, *decumbens*, &c.

[6] The species where this union takes place to its fullest extent is *S. Lindleyana*, whose ovary in this respect recalls that of *Vauquelinia*, while its carpels are also alternipetalous; so that *S. Lindleyana* links *Vauquelinia* and *Spiræa*. More frequently the carpels of the latter genus are only united for a very little way above the base.

[7] There are usually only two in *S. Filipendula*, and they become almost superposed. *S. Aruncus*, *lævigata*, &c., have often two pairs of descending ovules. *S. lobata* has two ovules, or more rarely a single one.

Again one may rise up and become obliquely ascending, with its micropyle downwards and inwards. The fruit consists of a variable number of follicles or pods,[1] and the seeds[2] contain within their membranous coats a fleshy embryo, either exalbuminous, or more rarely surrounded by a thin layer of cellular tissue.[3] In this genus we also find great variations in habit, vegetative organs, and inflorescence. It consists of shrubs, undershrubs, or herbs, sometimes very humble.[4] The leaves are alternate, simple, and entire, or lobed, pinnate, or even decompound. The petiole is accompanied by free or adnate lateral stipules, which may, as we have seen, be altogether absent. The flowers are axillary or terminal, in simple or compound racemes, spikes, or corymbs, or in clusters of pluriparous or even uniparous cymes.[5] Species of this genus are to be found in nearly all the cold and temperate regions of the northern hemisphere.[6]

Spiræa trifoliata[7] (fig. 442) has become the type of the genus *Gillenia*,[8] whose hermaphrodite flower possesses a tubular receptacle, somewhat contracted at the mouth, near which are inserted the calyx and androceum. The calyx consists of five quincuncial sepals,[9] and the corolla of five long alternating petals contorted in the bud.

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[1] Some fruits are even indehiscent. Those of *S. Ulmaria* are rolled up like a campylotropous seed.

[2] They become quite ascending in certain species, such as *S. Lindleyana*. Those of *S. Aruncus*, though similar in other respects, are pendulous. The singular form of the ripe carpels of *S. Ulmaria* causes the seeds to assume every possible direction. In none of these species is there albumen, which distinguishes *S. Aruncus* from *Astilbe*, to which TREVIRANUS has, however, referred it (*Bot. Zeit.* (1855), 817).

[3] "*In* S. parviflora...*embryone strato tenui albuminis donato.*" (B. H., *Gen.*, 612.)

[4] Several have even the habit of little cæspitose Saxifrages, with a rosette of little simple entire leaves, without much distinction of blade, petiole, and sheath. We may cite *S.* (*Petrophytum*) *cæspitosa* NUTT. (ex TORR. & GR., *Fl. N. Amer.*, 414), possessing simple or ramified racemes of flowers with long exserted stamens and an entire cupuliform disk. *Eriogyna* has the laciniate trifid leaves of many herbaceous Saxifrages. The names, *S. sorbifolia*, *Ulmaria*, *thalictroides*, *salicifolia*, &c., show pretty clearly how great are the variations of habit and foliage in this genus.

[5] The abortion of certain flowers of the cymes may be joined to the uplifting of the pedicels, producing the greatest abnormalities in the inflorescence. This is the case with *S. Filipendula* [Dropwort], a plant also remarkable for the swellings on its roots, from which it takes its name.

[6] CAMER., *De Ulmaria*, 1717.—WALD. & KIT., *Pl. Rar. Hung.*, t. 227.—JACQ., *Hort. Vindob.*, t. 88.—PALL., *Fl. Ross.*, t. 27, 28.—CAMBESS., *op. cit.*, 355-385; JACQUEM., *Voy. Bot.*, t. 37.—H. B. K., *Nov. Gen. et Spec.*, vi. 185, t. 562.—TORR. & GR., *Fl. N. Amer.*, i. 413.—A. GRAY, *Man. of Bot.*, ed. v. 149; *Pl. Wright. Tex.*, 54; *Pl. Fendl.*, 40.—CHAPM., *Fl. S. Unit.-States*, 120.—WEDD., *Chlor. And.*, ii. 231.—TORR. & GR., *Wippl. Rep.*, 164 (27), t. v.—BENTH., *Fl. Hongk.*, 105.—ROXB., *Fl. Ind.*, ii. 512.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 32; *Fl. Ind.-Bat.*, i. p. i. 389.—*Bot. Reg.*, t. 1365; 1840, t. 17; 1841, t. 4.—*Bot. Mag.*, t. 5151, 5165, 5169.—WALP., *Rep.*, ii. 49, 914; v. 657; *Ann.*, i. 287; ii. 521; v. 666.

[7] L., *Spec.*, 702.—CAMBESS., *Ann. Sc. Nat.*, sér. 1, i. 387, n. 33.—*Bot. Mag.*, t. 489.

[8] MŒNCH., *Meth.*, Suppl., 286.—NUTT., *Gen. Am.*, i. 307.—DC., *Prodr.*, ii. 546.—SPACH, *S it. à Buffon*, i. 447.—TORR. & GR., *Fl. N. Amer.*, i. 412.—A. GRAY, *Man. of Bot.*, ed. v., 150.—ENDL., *Gen.*, n. 6393.—B. H., *Gen.*, 613, n. 22.

[9] The edges of the sepals bear little sessile glands.

There are twenty stamens, echelonned in whorls on the upper part of the inside of the receptacular tube. The highest five stamens are exactly superposed to the sepals; then come five superposed to the petals; and there are again below these a third whorl of ten, one on either side of each of the latter set. These last may be absent, when the androceum will consist of only ten pieces. The filament of each

Gillenia trifoliata.

Fig. 442.
Branch.

stamen is at first reflexed on the wall of the tube, towards which is turned the face of the anther; but when the filament rises up, the anther becomes introrse; it has two cells and dehisces longitudinally. The receptacular tube is lined by a layer of glandular tissue; in the bottom of this is inserted the gynæceum, consisting of five free alternipetalous carpels, each formed of a one-celled ovary, surmounted by a terminal style, stigmatiferous at the apex. In the internal angle of the ovary is a placenta, bearing two rows of ascend-

ing anatropous ovules, whose micropyles look downwards and outwards.[1] The number of ovules in each row may be reduced to one or two. The fruit consists of five follicles, surrounded by the membranous receptacle; each contains one or more seeds, with thick coats inclosing a fleshy embryo with its radicle inferior, surrounded by a thin layer of albumen. The only two known species of *Gillenia* are perennial herbs from North America.[2] From the subterranean rhizome arise each year the aerial branches covered with alternate trifoliolate leaves, whose stipules are ill-developed in the one species,[3] and very large in the other.[4] Their flowers are in terminal clusters of few-flowered cymes.

Neillia[5] also comes very near *Spiræa* in some of its species, though it is very easy to distinguish and characterize the prototype of the genus, *N. thyrsiflora*.[6] Here the receptacle forms a long tube, in whose throat is inserted a calyx of five sepals, imbricated when young, and a corolla of as many little alternating petals, also originally imbricated. The stamens, of which there are twenty or upwards, are arranged in whorls as in *Spiræa;* each stamen has a short filament inflexed in the bud, and an introrse anther. The gynæceum consists of two free carpels, or more usually of a single one inserted in the bottom of the receptacle. These carpels resemble those of most species of *Spiræa,* and the ovary contains a variable number of ovules inserted in two rows upon the internal angle.[7] The fruit consists of one or two follicles,[8] and the seeds contain in their coats a fleshy embryo, surrounded by an equally fleshy albumen. To *Neillia* proper botanists have added certain plants formerly held to constitute the section *Physocarpus*[9] of *Spiræa,* the best known of which is *S. opulifolia*.[10] In its flowers the receptacular tube is shorter and more everted than in *S. thyrsiflora,* with sometimes only

[1] There may be as many as four or six in each row. They have two coats.

[2] TORR. & GR., *Fl. N. Amer.*, i. 418.—A. GRAY, *Man. of Bot.*, ed. v. 150.—CHAPM., *Fl. S. Unit.-States*, 121.

[3] *G. trifoliata* MŒNCH, *loc. cit.*—DC., *Prodr.*, n. 1.

[4] *G. stipulata.*—*G. stipulacea* NUTT., *loc. cit.*—DC., *Prodr.*, n. 2.—*Spiræa stipulata* MUEHL., ex W., *Enum.*, i. 542.—POIR., *Dict.*, Suppl., v. 221.—CAMBESS., *op. cit.*, 388, n. 34, t. 28.—*S. trifoliata* var. *incisa* PURSH., *Fl. Am. Sept.*, ed. 2, i. 343.

[5] DON., *Prodr. Fl. Nepal.*, 228.—DC., *Prodr.*, ii. 546.—ENDL., *Gen.*, n. 4644[1].—HOOK. F. & THOMS., *Journ. Linn. Soc.*, ii. 75.—B. H., *Gen.*, 612, n. 19. *Adenilema* BL., *Bijdr.*, 1121.—ENDL., *Gen.*, n. 4666.

[6] DON., *loc. cit.*—DC., *Prodr.*, 547, n. 1.

[7] As in *Gillenia*, they possess two coats.

[8] They are surrounded by the persistent calyx, covered with glandular hairs.

[9] CAMBESS., *op. cit.*, 385.

[10] L., *Spec.*, 702.—DC., *Prodr.*, ii. 542, n. 1.—SPACH, *Suit. à Buffon*, i. 431.

one or two carpels, sometimes three, four, or five. The fruit is here also a swollen follicle; and the ovules, though less numerous than in *N. thyrsiflora*, are still arranged in two vertical rows. They are at first horizontal, but are afterwards displaced, so that as seeds some become ascending with the micropyle extrorse, while others are more or less descending.[1] Thus constituted, the genus *Neillia* includes four or five species from India, the east and north[2] of Asia, and North America. These are bushy shrubs, with alternate simple dentate or lobed leaves, possessing two large lateral, caducous stipules. Their flowers are in racemes or corymbs, which may be simple or composed of alternate cymes.

In *Kerria*[3] the solitary terminal floral peduncle is swollen at the apex, with only a shallow pit on top for the insertion of the gynæceum; while the low edges of this pit bear five persistent quincuncially imbricated sepals, five alternating shortly-unguiculate petals also imbricated[4] in the bud, and a large number of free stamens[5] consisting of slender filaments, at first flexuous, bearing introrse two-celled anthers, dehiscing longitudinally. The cup is lined with hairs and glandular tissue. The carpels are superposed to the sepals when they are of the number;[6] each consists of a free ovary, and a slender style inserted at a variable height on the internal angle, and truncate and stigmatiferous at the apex. Within the ovary, about half-way up the ventral angle, is inserted a single incompletely anatropous descending ovule,[7] whose micropyle looks upwards and outwards. The fruit consists of a variable number of achenes,[8] whose seeds possess an exalbuminous embryo with its radicle superior. Only one species of this genus is known, *K. japonica*,[9] a shrub, cultivated in China and Japan from time imme-

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[1] There is a thin layer of albumen around the embryo.

[2] MIQ., *Fl. Ind.-Bat.*, i. p. i. 390.—HOOK. F. & THOMS., *Journ. Linn. Soc.*, ii. 75.—WALP., *Ann.*, iv. 669.

[3] DC., *Trans. Linn. Soc.*, xii. 156; *Prodr.*, ii. 541.—SPACH, *Suit. à Buffon*, i. 429.—ENDL., *Gen.*, n. 6390.—B. H., *Gen.*, 613, n. 23.

[4] They are sometimes contorted.

[5] Their arrangement and structure are the same as in the Roses; the inner stamens are far shorter than the outer ones.

[6] There are sometimes only four, sometimes, again, six or eight.

[7] It has only a single coat.

[8] "*Achenia parva, sicca, cartilaginea.*" We have never seen them in any collection. Till quite recently the plant cultivated almost exclusively in our gardens has been the monstrosity with double sterile flowers, and the carpels often opened out and leafy.

[9] DC., *loc. cit.*—SIEB. & ZUCC., *Fl. Jap.*, 183, t. 98.—MIQ., *Mus. Lugd. Bat.*, iii. 33.—*Rubus japonicus*, L., *Mant.*, 245.—*Corchorus japonicus* THUNBG., *Fl. Jap.*, 227.—W., *Spec.*, ii. 1218.—POIR., *Dict.*, ii. 105.—ANDR., *Bot. Repos.*, t. 587.—*Bot. Mag.*, t. 1296.—*Spiræa japonica* DESVX., *Mém. Soc. Linn. Par.*, i. 25. —CAMBESS., *Ann. Sc. Nat.*, sér. 1, i. 389.—*Teito Jamma Buki* KÆMPF., *Amœn. Exot.*, 844.

morial; it has scaly buds, and simple alternate leaves, with lateral caducous stipules.

In Japan has been found another plant, which has been made the type of a new genus, *Rhodotypos*;[1] its flower (fig. 443) is externally that of *Kerria*, but differs markedly from it in internal organization. It is normally constructed on the quaternary type. Its receptacle forms a broad shallow funnel; on this are borne in order from below upwards (*i. e.*, from centre to circumference) the gynæceum, a peculiar disk, the androceum, and the perianth. The four

Rhodotypos kerrioides.

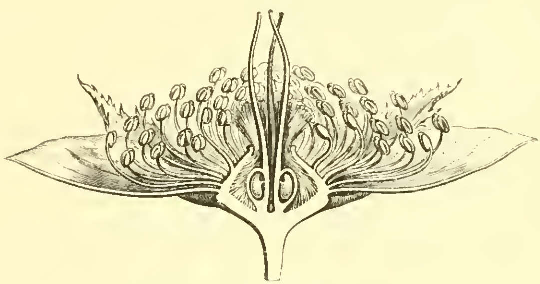

Fig. 443.
Longitudinal section of flower.

sepals are imbricated in the bud, and are accompanied by bracts which form a calycle, as in *Fragaria* or *Potentilla*. The alternating sepals are also imbricated in the bud, and resemble those of the Rose. The stamens are indefinite[2] in number, each formed of a free slender filament, and an introrse two-celled anther, dehiscing longitudinally. They are inserted over a large area, not only on the inner wall of the receptacle, but also on the outer surface of a disk, which forms a sort of roof covering in the whole of the ovarian portion of the gynæceum, and only allowing the larger portion of the styles to traverse the opening at its apex. The carpels are four in number,[3] superposed to the petals, and are lodged in the chamber formed below by the bottom of the receptacle, and above by the singular disk of which we have just spoken. Each consists of a free ovary,

[1] Sieb. & Zucc., *Fl. Jap.*, 187, t. 99.—Endl., *Gen.*, n. 6393[1], Suppl., ii. 95.—B. H., *Gen.*, 613, n. 24.

[2] They are originally arranged in four bundles, with the youngest elements innermost. The androceum may hence be considered as made up of four compound staminal leaves.

[3] This is the normal number, like that of the sepals or petals. But just as these may be increased to five or six in cultivated flowers, so we may find as many as seven or eight carpels collected into a sort of head, recalling the norma fruit of *Rubus*.

surmounted by a style which is stigmatiferous, but scarcely dilated, at the tip. In the ventral angle of each ovary is a placenta bearing two collateral, descending, incompletely anatropous ovules, with their micropyles upwards and outwards. The multiple fruit consists of five drupes or fewer,[1] with a membranous epicarp and a thin mesocarp, at first fleshy, later floury and friable. The stone is hard and one-seeded. Within the membranous seed-coats is contained a large fleshy embryo with its radicle superior, surrounded by a scanty albumen. The only known species of this genus is *R. kerrioides*,[2] a shrub possessing opposite, petiolate, simple leaves, with two lateral stipules, just like those of *Kerria*. The flowers are solitary, terminal, and pedunculate.

Neriusia[3] is a shrub with apetalous hermaphrodite flowers. The receptacle forms a shallow cup, lined by glandular tissue, and bears on its edges a calyx of five large dentate leafy sepals, imbricated in the bud. The stamens are very numerous, inserted within the calyx, and analogous to those of *Kerria* and *Rhodotypos*. The gynæceum consists of four free sessile carpels,[4] inserted towards the bottom of the receptacle, and each formed of a one-celled ovary, surmounted by a slender incurved style, nearly terminal, and stigmatiferous along the whole of its internal angle. Within the ventral angle of the ovary is a single descending nearly anatropous ovule, whose micropyle looks upwards and outwards. The fruit consists of one or more drupes with thin mesocarps, surrounded by the accrescent calyx. The embryo has a superior inflexed radicle and flattened cotyledons, surrounded by fleshy albumen. *N. alabamensis*[5] is the only known species of this genus, a glabrous shrub with the habit of several species of *Spiræa*. It has alternate simple[6] leaves with two little lateral stipules. Its flowers[7] are on rather long slender pedicels, forming, as it were, few-flowered umbels terminating the young branches.

Finally, the genus *Stephanandra*[8] may be defined as *Spiræa* with a

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[1] By abortion of one or more of the normal carpels. But in cultivated plants we find ripe fruits with a larger number of drupes (see p. 381, note 3).

[2] SIEB. & ZUCC., *loc. cit.*—WALP., *Rep.*, v. 658.—MIQ., *Mus. Lugd. Bat.*, iii. 33.

[3] A. GRAY, *Mem. Amer. Acad.*, n. ser., vi. (1858) 374.—*Neriusa* B.H., *Gen.*, 613, n. 25.

[4] More rarely two or three.

[5] A. GRAY, *loc. cit.*, t. xxx.

[6] "*Membranacea duplicato-serrata.*"

[7] They are said to be white, like those of *Rhodotypos*.

[8] SIEB. & ZUCC., *Abhand. Münch. Akad.*, iii. 739, t. 4, fig. 2.—ENDL., *Gen.*, n. 6392[1], Suppl. iii. 102.—B. H., *Gen.*, 612, n. 20.

diplostemonous androceum and a unicarpellary gynæceum. In fact, its flowers possess a campanulate receptacle, lined by a thin glandular disk, and bearing on its edges five sepals and five alternating petals (both sets imbricated), and ten stamens with introrse anthers superposed to the perianth-leaves; while in the bottom of its concavity is inserted the single carpel, whose one-celled ovary contains two ovules, at first descending,[1] placed side by side on a parietal placenta, and with their raphes towards it; the style is terminal with a capitate stigma. The fruit is a follicle, enveloped in the persistent receptacle, and enclosing one or two ascending or descending seeds, which each contain an embryo with its radicle inferior or superior, and with orbicular cotyledons surrounded by a variable thickness of fleshy albumen. The only known species[2] is a Japanese shrub with slender flexible branches, scaly leaf-buds, and alternate incised leaves, whose petiole has two lateral stipules at its base. The inflorescence consists of short racemes or simple or compound corymbs of flowers, very like those of *Prinsepia;* while in their unicarpellary gynæceum they come very close to those of the *Pruneæ* generally; so that *Stephanandra* among the *Spireeæ* represents a reduced type, like that of *Purshia* among the *Fragarieæ*, or *Chamæmeles* in the *Pyreæ*.

V. QUILLAJA SERIES.

Quillaja[3] (figs. 444–447) has regular diœcious or hermaphrodite flowers. In the hermaphrodite ones we find a pentamerous calyx and corolla inserted on the circumference of a shallow concave receptacle. The sepals are valvate in æstivation, while the petals are imbricated; but this can only be ascertained when young, for they are small and spathulate, and early cease touching. The receptacle is lined by a glandular disk, whose five lobes are prolonged along the

[1] Later on they may become transverse, with their raphes inferior; or one of them may even become ascending in certain flowers.

[2] *S. flexuosa* SIEB. & ZUCC., *loc. cit.*—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 33.—*Spiræa incisa* THUNGB., *Fl. Jap.*, 213.—CAMBESS., *loc. cit.*, 262.—SER., in DC. *Prodr.*, n. 9.

[3] MOL., *Chil.*, ed. 2, 298.—J., *Gen.*, 444.—H. B. K., *Nov. Gen. et Spec.*, vi. 236, not.—LAMK., *Dict.*, vi. 33; Suppl., iv. 638; *Ill.*, t. 774.—DC., *Prodr.*, ii. 547.—SPACH, *Suit. à Buffon*, i. 448.—DON, *Edinb. New Philos. Journ.*, xii. 110.—LINDL., *Veg. Kingd.*, 564.—GUILLEM., *Dict. d'Hist. Nat.*, xiv. 419.—ENDL., *Gen.*, n. 6397.—B. H., *Gen.*, 614, n. 28.—*Smegmadermos* R. & PAV., *Prodr.*, 133, t. 31.—*Smegmaria* W., ex GUILLEM., *loc. cit.*—*Fontenellea* A. S. H. & TUL., *Ann. Sc. Nat.*, sér. 2, xvii. 141, t. 7.

inner faces of the sepals, while in the bottom of the sinuses between them are inserted the petals. Internal to these, a little lower down, are inserted five superposed stamens; there are also five others, larger, placed higher up, and superposed to the sepals, inserted in

Quillaja Saponaria.

Fig. 441.
Branch.

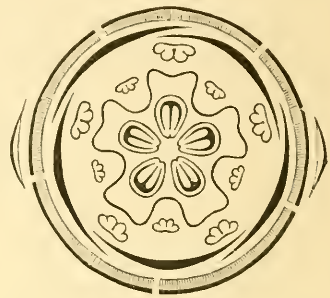

Fig. 447.
Diagram.

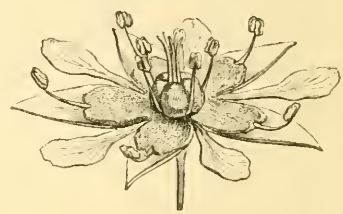

Fig. 445.
Hermaphrodite flower.

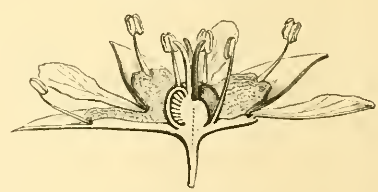

Fig. 446.
Longitudinal section of hermaphrodite flower

the little notches at the apices of the lobes of the disk. In both sets each consists of a free tapering filament, inflexed in the bud, and bearing a versatile, introrse, two-celled anther, dehiscing longitudinally. In the centre of the flower the receptacle rises up into a little cone,[1] bearing on its convexity five carpels superposed to the

[1] The existence of this cone representing the organic apex of the receptacle, produces a very oblique insertion of the base of the carpels, so that they appear united below into a single many-celled ovary, nearly as in *Spiræa Lindleyana*, and several allied species.

sepals. Each of these consists of a one-celled ovary, tapering into a style, which is grooved along the whole of its internal angle, and ends in a slight stigmatiferous swelling. In the ventral angle of each ovary is a vertical placenta, bearing on each of its two lips a row of horizontal nearly anatropous ovules, early flattened against one another. In the fruit, which consists of five pods,[1] spreading into a star, these ovules have become imbricated, ascending, compressed seeds, each surmounted by a long broad wing, and containing a fleshy embryo with convolute cotyledons. This genus consists of South American trees; three species are known, from Brazil, Peru, and Chili.[2] Their leaves are persistent, simple, and alternate, with two little lateral caducous stipules. The flowers are in axillary or terminal, usually few-flowered, biparous cymes. The central flower is nearly always hermaphrodite.

Kageneckia oblonga.

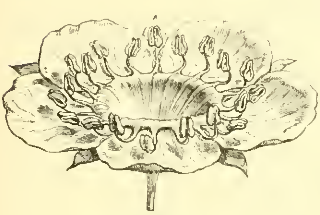

FIG. 448.
Male flower.

FIG. 450.
Seed.

FIG. 451.
Longitudinal section of seed.

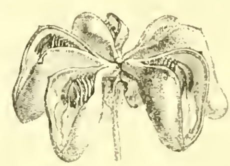

FIG. 449.
Fruit dehiscing.

Kageneckia[3] may be considered as *Quillaja* with an imbricate calyx and an androceum of more than ten stamens. The flowers are unisexual, oftentimes diœcious. In the male flower (fig. 448), the receptacular cup bears on its edges five quincuncial sepals, five alternate petals, and a score of stamens, five superposed to the sepals, and the

[1] They are usually described as follicles, but pod or legume would appear the preferable expression, each carpel dehiscing when ripe by two clefts, one ventral, the other dorsal.

[2] H. B. K., *Nov. Gen. et Spec.*, vi. 236, not.—C. GAY, *Fl. Chil.*, ii. 273.—HOOK. F., in MART. *Fl. Bras.*, *Rosac.*, 57.—WALP., *Rep.*, ii. 52; v. 659.

[3] R. & PAV., *Prodr. Fl. Per.*, 134, t. 37.—POIR., *Dict.*, Suppl. iii. 211; v. 714.—DC., *Prodr.*, ii. 547.—DON, in *Edinb. New Phil. Journ.*, xii. 111.—ENDL., *Gen.*, n. 6396.—B. H., *Gen.*, 614, n. 29.—*Lydæa* MOL., *Chil.*, ed. 2, 300.

rest in threes superposed to the petals. Each consists of a free filament, and an introrse two-celled anther, dehiscing longitudinally. The female flower has the same perianth, but the stamens have only small sterile anthers, and on the slightly prominent summit of the receptacle are inserted five free alternipetalous carpels, each consisting of a one-celled ovary, and a style inserted on the ventral angle, with a dilated two-lobed stigmatiferous apex. Within the ventral angle of each ovary we observe a parietal placenta, bearing two vertical rows of more or less ascending imbricated anatropous ovules. The concavity of the receptacle is lined by a layer of glandular tissue. The multiple fruit consists of five follicles in a star; they are originally ascending, but rapidly become bent back, so that their free ends look outwards and downwards, while above, at a slightly higher level than the base, is an obtuse hump.[1] The seeds are numerous, with terminal wings, as in *Quillaja*, and exalbuminous. Three or four species of *Kageneckia*[2] are known, trees from Chili and Peru. Their leaves are alternate, coriaceous, and persistent, with two caducous stipules at the base. The flowers are terminal, or more rarely axillary. The female flowers are collected in cymose panicles.

The hermaphrodite flowers of *Vauquelinia*[3] (figs. 452–455) also differ but little from those of *Quillaja*. The concave receptacle lined by a layer of glandular tissue with entire edges, the five valvate sepals, the five imbricate petals, the dry fruit, the winged seeds, are all nearly the same in both genera. The principal differences lie in the fruit, and in the number of pieces of the androceum and of ovules. *Vauquelinia* has, in fact, about twenty stamens;[4] of these five are superposed to the petals, five to the sepals, while of the ten others one stands on either side of each of the latter set. They all possess free perigynous filaments, and introrse two-celled anthers, which dehisce longitudinally and then become versatile. Here, also, the receptacle is slightly prominent in the centre to give insertion to the gynæceum. This consists of five alternipetalous carpels, incompletely united below into a five-celled ovary,[5] but quite free in their

[1] The organic apex.

[2] H. B. K., *Nov. Gen. et Spec.*, vi. 186.—C. Gay, *Fl. Chil.*, ii. 269.—Lindl., *Bot. Reg.*, t. 1836.—Walp., *Rep.*, ii. 52; *Ann.*, iii. 857.

[3] Corr., in H. B., *Pl. Æquin.*, i. 140, t. 40.—H. B. K., *Nov. Gen. et Spec.*, vi. 187.—Poir., *Dict.*, Suppl., v. 156; *Ill.*, cent. 10, ic.—DC., *Prodr.*, ii. 547.—Endl., *Gen.*, n. 6398.—B. H., *Gen.*, 615, n. 30.

[4] We sometimes find twenty-five, owing to the deduplication of the alternipetalous ones.

[5] As in *Spiræa Lindleyana* and the allied species (see p. 376, note 6), which link together the two genera *Vauquelinia* and *Spiræa*.

stylar parts, which form little rods dilated and stigmatiferous at the apex. Near the base of the ventral angle of each cell we find two collateral ascending anatropous ovules, whose micropyles look down-

Vauquelinia corymbosa.

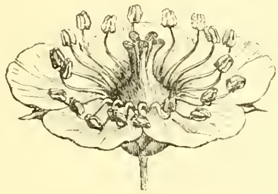

FIG. 452.
Flower.

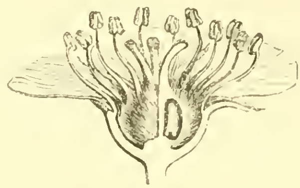

FIG. 453.
Longitudinal section of flower.

FIG. 454.
Fruit.

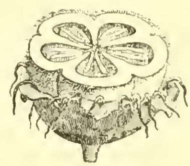

FIG. 455.
Transverse section of fruit.

wards and outwards. In the bud they are already flattened and membranous above; and in the fruit they become winged exalbuminous seeds, as in *Quillaja*. The pericarp is dry; first it separates into five divisions, each representing a cell, and then each cell opens into two halves from above downwards. As yet only one species of the genus is known, *V. corymbosa*, a Mexican tree with alternate serrate leaves, whose long petioles have two very small glandular lateral stipules. Its flowers are grouped in very dense terminal ramified cymose panicles, in which the lateral ramifications are axillary either to bracts or to the uppermost leaves of the branch.

Lindleya[1] would have altogether the flower of *Vauquelinia* but for its imbricated sepals[2] and suspended ovules. If we analyse a bud of *L. mespiloides*,[3] the only known species of the genus, we find that it

[1] H. B. K., *Nov. Gen. et Spec.*, vi. 188, t. 562 *bis.*—DC., *Prodr.*, ii. 548.—ENDL., *Gen.*, n. 6399.—B. H., *Gen.*, 615, n. 32.

[2] The receptacle is sac-like, and somewhat recalls that of the Rose, though not so contracted above.

[3] H. B. K., *loc. cit.*—LINDL., *Bot. Reg.* (1844), t. 27.—DECNE., *Rev. Hortic.* (1851), 81, t. 5.

is hermaphrodite; on the edges of the concave receptacle are borne five unequal quincuncially imbricated sepals, and as many alternating petals, also imbricated. There are a score of perigynous stamens inserted towards the edge of the glandular disk lining the receptacular cup, each composed of a free filament and an introrse two-celled anther, dehiscing longitudinally. The gynæceum consists of an ovary of five alternipetalous cells,[1] each surmounted by a style with an irregularly dilated and stigmatiferous apex; and in the ventral angle of each are two collateral descending anatropous ovules, whose micropyles look upwards and outwards.[2] An elongated obturator, formed by a prominence of the placenta, projects above each micropyle. The fruit is woody and loculicidal, separating into five thick valves when ripe. The seeds are compressed and winged, containing a fleshy, exalbuminous embryo, with its radicle superior. *L. mespiloides* is a small Mexican tree, with simple, alternate leaves, and little lateral caducous stipules. The flowers are solitary, terminal, or they more rarely form a few-flowered terminal cyme. On the peduncle of each flower are two bracts.

Exochorda grandiflora.

FIG. 456. Fruit.

With the habit and foliage of *Spiræa*, to which it was formerly joined, *Exochorda*[3] (fig. 456) possesses flowers exactly like those of *Lindleya*,[4] *i.e.*, a concave receptacle, lined by a glandular disk, bearing on its edges five quincuncial sepals, as many imbricated petals, and fifteen or twenty stamens of the *Rosaceæ*;[5] also an ovary of five cells, surmounted by an equal number of styles dilated and stigmatiferous at their apices, and containing in the ventral angle of each cell two descending ovules, whose micropyles look upwards and outwards, and are capped by a cellular obturator. The fruit alone is markedly different. The perianth and receptacle come off it altogether, leaving it quite bare as a capsule with five thick obtuse wings, gradually tapering towards the base and rounded on the back, all united round the central axis from which they radiate, their intervals forming deep dihedral angles.

[1] These cells are usually incomplete, so that the placentas really become parietal.

[2] With two coats.

[3] LINDL., *Garden. Chron.* (1858), 925.—B. H., *Gen.*, 612, n. 21.

[4] They are sometimes tetra- or hexamerous.

[5] There are nearly always three in front of each petal, the median one being smallest, and inserted below the other two. It is those in front of the sepals which may sometimes be quite absent.

Later on they separate, and then open longitudinally along the middle line into two thick coriaceous panels to free one or two compressed winged seeds, with membranous edges. The embryo is flattened, fleshy, and exalbuminous, with its radicle superior.[1] Of the genus *Exochorda* two species are known,[2] glabrous shrubs from the north and east of Asia, with alternate, simple, exstipulate leaves. The flowers are usually polygamo-diœcious; they come out in the spring in axillary or terminal racemes, each flower axillary to a bract, and with two lateral bractlets near the summit of its pedicel.

In this group has also been placed *Pterostemon*,[3] on account of its stipulate leaves and exalbuminous seeds, despite its strong analogies with the *Saxifragaceæ*. On the edges of its turbinate receptacle are inserted five valvate sepals, as many alternating imbricated petals, and ten stamens superposed to these perianth-leaves. The five superposed to the petals are shorter, with narrow flattened filaments; the others have broad filaments, divided above into three teeth, of which the middle one bears a cuspidate introrse anther with a dorsal thickened connective. The ovary, lodged in the hollow of the receptacle, is surmounted by a style, dividing above into five truncate lobes stigmatiferous at the apex. In the ovary we find five pluriovulate cells;[4] and the fruit, surmounted by the remains of the perianth[5] and androceum, is a five-celled septifragal capsule, containing one or more seeds which are ascending, like the ovules, and contain an exalbuminous embryo with its radicle inferior. *P. mexicanus*, the only known species of this genus, is a bushy shrub possessing dichotomous branches, and alternate simple petiolate leaves,[6] with two lateral stipules. The flowers are in few-flowered corymbose cymes.

Eucryphia[7] has regular hermaphrodite flowers, usually tetramerous.

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[1] The radicle is conical, subarcuate. The cotyledons are flat on the inside, with convex backs. Below their insertion each is prolonged into two descending auricles, which touch each other laterally, and form a pretty long sheath around the base of the radicle.

[2] One is the so-called *Spiræa grandiflora* (Hook., *Bot. Mag.*, t. 4795.—Her., *Hortic. Franc.* (1867), 250, t. viii.). Its flowers are described as polygamo-diœcious, but we have found them all hermaphrodite, though it is true that our individuals were cultivated, and their vegetation very vigorous. The other species described by us under the name of *E.? Davidiana* (*Adansonia*, ix. 149, no. 22), is doubtful, for the single individual studied only possessed male flowers. Now, except as regards the gynæceum, *Exochorda* is undistinguishable from *Nuttallia*, to which genus, therefore, the last species might perhaps belong.

[3] Schauer, *Linnæa*, xx. 736.—B. H., *Gen.*, 615, n. 31.—Walp., *Ann.*, i. 288.

[4] There are from four to six ovules inserted in the ventral angle of each.

[5] The petals are withered and reflexed.

[6] They are glandular on the upper surface, downy on the lower.

[7] Cav., *Icon.*, iv. 49, t. 372.—Chois., *Prodr.*

On the convex receptacle, passing from below upwards, are inserted a calyx of four free imbricated sepals, as many petals also imbricated[1] in the bud, and resembling those of the Rose, and an indefinite number of free hypogynous stamens arranged in many rows. Each consists of a slender filament and an introrse two-celled anther,[2] dehiscing longitudinally. Around the summit of the receptacle are inserted on one level the carpels, varying from five to fifteen in number. These cohere below into an elongated many-celled ovary, above which they become free to form tapering styles, stigmatiferous, but hardly, if at all, dilated at the apex. In the internal angle of each cell are inserted an indefinite number of descending anatropous ovules,[3] in two vertical rows; their micropyles look upwards and outwards. The fruit is a capsule with a coriaceous mesocarp and a woody endocarp, which divide septicidally into as many divisions as there were cells, each containing one or more compressed imbricated seeds, whose chalazal region is prolonged into a membranous wing. Beneath the integuments is a fleshy albumen of no great thickness surrounding a green embryo, with its radicle superior and with flattened elliptical cotyledons. For a long time only three species of this genus were known. Two of these are natives of Chili; the one[4] has pinnate leaves, quite like those of the Roses, but they are opposite and persistent, with large interpetiolar stipules at the base. The second species[5] has, on the contrary, simple leaves, with the stipules not well developed. The third species comes from Australia;[6] its leaves are also simple, but with large stipules. All have solitary axillary pedunculate flowers, but towards the summit of the branch, where the leaves are replaced by bracts with a flower[7] in the axil of each, the whole inflorescence becomes a true terminal raceme, with the flowers borne on opposite decussate pedicels, and often very numerous and crowded.[8]

Hyper., 62.—DC., *Prodr.*, i. 556.—ENDL., *Gen.*, n. 5103.—SPACH, *Suit. à Buffon*, v. 344, not.—H. BN., *Adansonia*, v. 303.—B. H., *Gen.*, 616, n. 33.—*Carpodontes* LABILL., *Voy.*, ii. 16, t. 18; *Pl. Nouv.-Holl.*, ii. 122.—CHOIS., *op. cit.*, 61.—DC., *loc. cit.*

[1] Or more rarely contorted.

[2] The two cells are often pendulous, and only attached above to the connective.

[3] Or incompletely amphitropous.

[4] *E. glutinosa.*—*E. pinnatifolia* C. GAY, *Fl. Chil.*, i. 352, t. 8 (1845).—*Fagus glutinosa* PŒPP. & ENDL., *Nov. Gen. et Sp.*, ii. 68, t. 194 (1838).

[5] *E. cordifolia* CAV., *loc. cit.*—C. GAY, *op. cit.*, 351.

[6] *E. lucida* (*E. Billardieri* SPACH, *loc. cit.*—BENTH., *Fl. Austral.*, ii. 446.—*E. Milligani* HOOK. F., *Fl. Tasm.*, i. 54, t. 8.—*Carpodontos lucida* LABILL., *loc. cit.*). F. MUELLER has made known (*Fragm.*, iv. 2), another Australian species, with pinnate leaves, *E. Moorei* (BENTH., *op. cit.*, 447, n. 2).

[7] Below the flower the pedicel may bear alternate imbricate scaly bracts.

[8] We were the first to refer *Eucryphia* to the *Rosaceæ*. BENTHAM & J. HOOKER have now

The flower of *Euphronia*[1] is hermaphrodite, with a cup-shaped receptacle, bearing on its edges four or five unequal sepals, and perhaps, too, a perigynous corolla.[2] The stamens have the same insertion, and are as numerous as the sepals and superposed to them. Their filaments are broad at the base, where they cohere in a variable manner,[3] but are free above and taper to a point.[4] The gynæceum is very much like that of *Eucryphia*, inserted in the bottom of the receptacle. It consists of an ovary with three uniovulate cells, surmounted by a filiform persistent style bearded below. The fruit is a capsule surmounted by the remains of the style, and accompanied at the base by the receptacle and the reflexed sepals. It has a pretty thick mesocarp; this separates from the woody endocarp which is septicidal, with its clefts prolonged into the style. Each stone then opens along the ventral angle to free a descending seed prolonged below into a long flattened wing, and containing within its coats a fleshy embryo with its radicle superior, surrounded by a thin layer of albumen. Only one species of this genus is known,[5] a native of the north of Brazil. Its woody branches bear alternate exstipulate petiolate simple leaves. Its flowers are in terminal racemes.[6]

adopted our view, but they at first (*Gen.* 164, 195) shared that of PLANCHON (*Ann. Sc. Nat.*, sér. 4, ii. 261), who places *Eucryphia* among the *Saxifragaceæ*.

1 MART., & ZUCC., *Nov. Gen. et Spec.*, i. 121, t. 73.—ENDL., *Gen.*, n. 6400.—B. H., *Gen.*, 317, 616, n. 34.

2 The fruits alone being known, the petals, if there ever were any, must have fallen off in the specimens in the Munich herbarium.

3 They have been described as diadelphous, four being united into one bundle. But we have seen more than one free filament around the one young fruit we have been able to examine.

4 The anthers are unknown.

5 *E. hirtelloides* MART. & ZUCC., *l.c. cit.*—WALP., *Rep.*, v. 659.—HOOK. F., in MART., *Fl. Bras.*, *Rosac.*, 60.

6 Next to *Euphronia* has been placed the genus *Canotia* (TORR., ap. WIPPL., 12), whose flower is pentamerous, with a five-lobed persistent calyx and five hypogynous stamens. Its fruit is a five-celled septicidal capsule, surmounted by the subulate style. In each cell is a suspended seed, whose coats are prolonged below into a membranous wing, and contain an embryo in the axis of fleshy albumen. The only species known is *C. holocantha*, a shrub from New Mexico, with leafless branches, whose alternate twigs end in long spines. BENTHAM and HOOKER say of this plant "*Genus quoad affinitatem valde dubium*" (*Gen.*, 616, n. 35). As yet the corolla has not been seen, so that the characters appear to have been made out from fruiting specimens only.

VI. PEAR SERIES.

The Pears[1] (Fr., *Poiriers*—figs. 457–462) have regular hermaphrodite flowers.[2] Their receptacle has the same shape, like a pouch or gourd, as in the Roses,[3] and on its edges are inserted the perianth

Pyrus communis (*Pear*).

FIG. 457.
Flowering branch.

and androceum. The sepals are five in number, free, and quincuncially imbricated in the bud. The imbricated, shortly unguiculate petals are of the same number as the sepals, and alternate with them. The stamens are twenty in number, or upwards; if twenty, they are arranged like those of *Spiræa*, *Fragaria*, &c. (fig. 459).[4]

[1] *Pyrus* T., *Instit.*, 628, t. 404.—L., *Gen.*, n. 626.—ADANS., *Fam. des Pl.*, ii. 296.—J., *Gen.*, 335.—GÆRTN., *Fruct.*, ii. 44, t. 87.—LAMK., *Dict.*, v. 450; Suppl., iv. 451; *Ill.*, t. 435.—LINDL., *Trans. Linn. Soc.*, xiii. 97.—DC., *Prodr.*, ii. 633.—SPACH, *Suit. à Buff.*, i. 109.—ENDL., *Gen.*, n. 6342.—PAYER, *Organog.*, 499, t. cii. fig. 35.—B. H., *Gen.*, 626, n. 63 (incl. *Pyrophorum* NECK., *Apyrophorum* NECK., *Azarolus* CLS., *Lazarolus* MEDIK., *Halmia* MEDIK., *Aria* L., *Torminaria* DC., *Aucuparia* MEDIK., *Sorbus* T., *Cormus* SPACH, *Malus* T.).

[2] They here and there become unisexual through the abortion of the gynæceum.

[3] But usually less constricted in the neck.

[4] Generally the stamens of the three whorls of the icosandrous androceum long remain of unequal sizes, and even in flower-buds of a good age we may easily perceive that the five stamens superposed to the sepals are shortest, and that the longest correspond with the median lines of the petals, while the stamens on each side of these are of middle size. The oppositisepalous stamens are often deduplicated.

Each consists of a free filament,[1] inflexed in the bud, and an introrse two-celled anther dehiscing longitudinally. Below the insertion of the stamens the receptacle is lined by a glandular disk of variable

Pyrus communis.

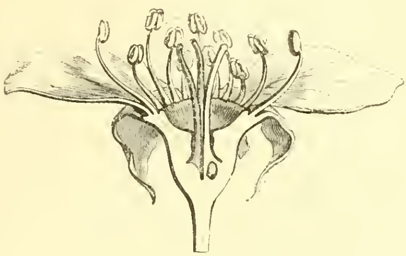

FIG. 458.
Longitudinal section of flower.

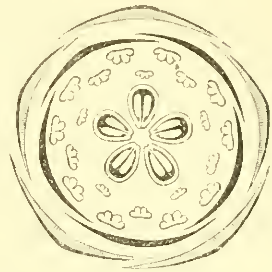

FIG. 459.
Diagram.

thickness at the edge, which may either reach the top of the receptacle, or leave bare a zone of variable breadth below the insertion of the perianth and androceum. The gynæceum consists either of five

Pyrus Malus (Common Apple).

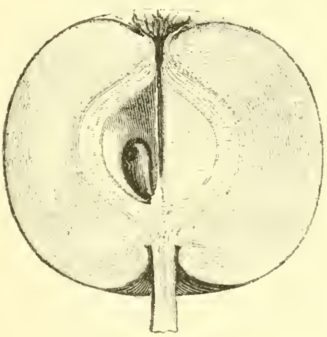

FIG. 460.
Longitudinal section of fruit.

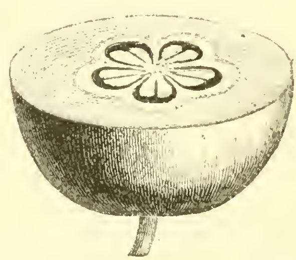

FIG. 461.
Transverse section of fruit.

carpels superposed to the sepals,[2] or of a smaller number, often two. Each is formed of an ovary buried in the bottom of the receptacle, whose free inner edge is traversed by a longitudinal groove, and continuous with an erect style terminating above the receptacular sac

[1] Or rarely cohering near its base with the neighbouring filaments, though only for a short extent, just as in *Eriogyna*.

[2] The pollen grains are ovoidal, with three folds, and in water they become spherical, with three bands, according to H. MOHL (*Ann. Sc. Nat.*, sér. 2, iii., 340). It is the same with all the *Pomaceæ* examined by this botanist.

in a stigmatiferous head. Within the ovary, close to the base of this angle, is seen a placenta, bearing two nearly erect anatropous ovules, placed side by side, with their micropyles downwards and outwards (fig. 458).[1] The fruit is a drupe, at the top of which is the so-called "eye," a depression formed by the original opening of the receptacular sac, usually surrounded by the persistent calyx, and sometimes also by the withered petals and stamens (fig. 460). In the centre of the very thick fleshy mesocarp the endocarp forms from two to five nuts, separated from each other by bands of the fleshy tissue, but free towards the axis, and usually surrounding a central space. Their walls are not very thick, and of scarious or

Pyrus Aria (*White Beam*).

Fig. 462.
Inflorescence.

parchment-like consistency. Each contains one or two ascending seeds, with fleshy exalbuminous embryos; the radicle is inferior.

The Apples[2] (Fr., *Pommiers*) were at first distinguished from the Pears, because their styles are not free at the base, but cohere into a column for some way up. The Service-trees[3] (Fr., *Sorbiers*) have been separated because their endocarp is membranous and fragile, and the number of carpels is usually less than five. But these characters, by no means constant and of altogether secondary value, have

[1] The micropyle is often covered by a more or less prominent obturator. The ovule has two coats.

[2] *Malus* T., *Instit.*, 631, t. 406.—Turp., *Dict. des Sc. Nat.*, t. 242.—Spach, *Suit. à Buff.*, ii. 133.

[3] *Sorbus* T., *Instit.*, 633.—L., *Gen.*, n. 623.—Spach, *op. cit.*, 91.—*Aucuparia* Medik., ex Endl., *loc. cit.*, f.—*Cormus* Spach, *op. cit.* 96.

not allowed the most recent authors to separate these from the Pear family, in which they form sections that are not at all sharply defined.

Thus constituted, this genus includes about forty species, trees or shrubs, from temperate regions of the northern hemisphere.[1] They have alternate simple or pinnate caducous leaves, with two lateral stipules. The flowers are grouped into corymbs,[2] rarely few-flowered, and either simple or composed of cymes (figs. 457, 462); each flower is axillary to a usually caducous acute bract.

The Quinces[3] (Fr., *Cognassiers*—figs. 463–465) have been referred by very many authors to the Pear family, from which they differ but very little.[4] Their carpels, instead of containing two ascending ovules, contain an indefinite number arranged in two vertical rows, with their raphes towards each other. Hence the fruit is a berry, with a thin endocarp and many-seeded cells. The fruit of *C. vulgaris*, the quince (Fr., *coing*), is surmounted by a calyx of large unequal erect leaves, and the flower is usually solitary terminal. In the Japan Quince,[5] of which it has been proposed to make the separate genus *Chænomeles*,[6] the flowers, which come out towards the end of the winter

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[1] DC., *loc. cit.*, 633-637.—Roxb., *Fl. Ind.*, ii. 510.—Lour., *Fl. Cochinch.*, 321.—Wall., *Pl. As. Rar.*, t. 173, 189.—Koch, *Ann. Mus. Lugd. Bat.*, i. 248, 249.—Miq., *op. cit.*, iii. 40.—Torr. & Gr., *Fl. N. Amer.*, i. 470.—A. Gray, *Man. of Bot.*, ed. v. 161.—Chapm., *Fl. S. Unit.-States*, 128.—C. Gay, *Fl. Chil.*, ii. 316.—Gren. & Godr., *Fl. de Fr.*, i. 570.—Hook., *Fl. Bor.-Amer.*, t. 68.—*Bot. Reg.*, t. 1437, 1482, 1484.—*Bot. Mag.*, t. 3668.—Walp., *Rep.*, ii. 53; *Ann.*, i. 287; ii. 522; iv. 669.

[2] These peculiar branches or *spurs*, ending in a large flower-bearing bud (Fr., *bourse*), are often thick and stumpy, only bearing a few leaves below the flowers. But in some cases these twigs are more elongated, and in the axil of each of their upper leaves is a ramification of the inflorescence, this being a cyme. The whole inflorescence is a terminal raceme of cymes, often vaguely described as a thyrse or panicle.

[3] *Cydonia* T., *Inst.*, 632, t. 405.—Heist., *De Cydon.*, 1744.—Adans., *Fam. des Pl.*, ii. 296.—J., *Gen.*, 335.—Gærtn., *Fruct.*, ii. 44, t. 87.—Lamk., *Dict.*, ii. 63; Suppl., ii. 426.—Thouin, *Ann. Mus.*, ix. t. 8, 9.—DC., *Prodr.*, ii. 638.—Spach, *Suit. à Buffon*, ii. 154.—Endl., *Gen.*, n. 6341.

[4] The common Quince (*Cydonia vulgaris* Pers., *Enchir.*, ii. 40;—DC., *Prodr.*, n. 1;—*C. europæa* Sav., *Alb. Tosc.*, i. 90;—*Pyrus Cydonia* L., *Spec.*, 687) has a subtubular receptacle, with sepals quincuncially imbricated in the young bud, and then reflexed, not touching one another at all at anthesis. The petals are nearly always twisted in æstivation. There are fifteen to twenty stamens, five alternipetalous, and the rest in groups of two or three, superposed to the petals. In the bud, we find a deep groove between the wall of the receptacle and the ovaries to receive the anthers, while the stamens are reflexed. The ovaries are said to adhere externally to the receptacle for a considerable extent; that is, each is inserted on the inside of this sac by a large oblique surface, corresponding with its organic base. Internally the carpels are quite free from each other. There are usually from five to seven ovules in each row; they have two coats. The sepals persist on top of the fruit, and are similar to the cauline leaves on a small scale. These last are accompanied by two ciliate laciniate stipules, contracted near their attachment, while the blade is unsymmetrical, projecting less on the side towards the petiole.

[5] *C. japonica* Pers., *Enchir.*, ii. 40.—DC., *Prodr.*, n. 4.—*C. speciosa* Guimp & Hayn., *Fremd. Holz.*, t. 70.—*C. lagenaria* Lois., *Herb. Amat.*, v. t. 67.—*Malus japonica* Andr., *Bot. Rep.*, t. 462.—*Pyrus japonica* Thunb., *Fl. Jap.*, 207.

[6] Lindl., *Trans. Linn. Soc.*, xiii. 97; *Bot. Reg.*, t. 905.—Spach, *op. cit.*, 158.

before the leaves, are solitary or in small clusters on the wood of the branches, usually springing from the axil of a last year's leaf or its

Cydonia vulgaris.

FIG. 463.
Flower.

FIG. 464.
Longitudinal section of flower.

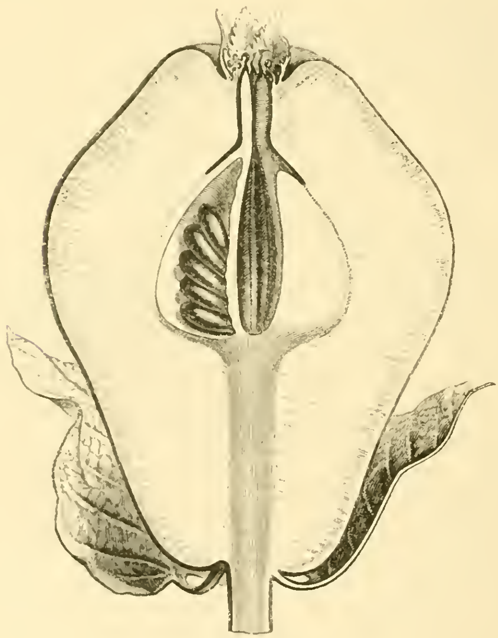

FIG. 465.
Longitudinal section of fruit.

cicatrix. Before expansion they are enveloped in the imbricated scales of a large bud.

The Hawthorns[1] (Fr., *Alisiers*) are also very near the Pears; they

[1] *Cratægus* T., *Instit.*, 633.—L., *Gen.*, 622.—J., *Gen.*, 335.—LAMK., *Dict.*, i. 82; Suppl., i. 291; *Ill.*, t. 133.—SPACH, *Suit. à Buffon*, ii. 98.—LINDL., *Trans. Linn. Soc.*, xiii. 105.—DC., *Prodr.*, ii. 626.—ENDL., *Gen.*, n. 6353.—B. H., *Gen.*, 626, n. 64.

may, indeed, be defined as Pears whose fruit is a drupe with stony putamina. Sometimes these are multiple, free, and one-celled; sometimes, on the contrary, there is only a single stone, divided into as many cells as there are seeds.[1] The number of these varies from one to five, either because the gynæceum originally consisted of fewer than five carpels, or because, of five cells originally present, one or more have had their development arrested with that of the ovules they contained.[2] In other respects the flower of the Hawthorns is organized like that of the Pears. So is that of the Medlar,[3] (Fr., *Néflier*), of which many authors have made a distinct genus, but which possesses a fruit with five bony nuts, and only differs from the other species of *Cratægus* in the large size of the eye,[4] seen on top of the fruit, surrounded by the persistent sepals.[5] Thus constituted, the genus *Cratægus* includes about thirty species nearly all proper to the northern hemisphere, *i.e.*, in Europe, Asia, and North America,[6] only one species inhabiting the Columbian Andes. They are trees or shrubs,[7] with alternate petiolate leaves possessing two caducous lateral stipules. The flowers are terminal, in the

[1] The latter case would be the more frequent according to BENTHAM and HOOKER: "*Drupa . . . . putamine osseo* 1–5-*loculari* (*rarius* 5-*pyrena, pyrenis osseis vix liberis*)." We have observed almost constantly, in specimens cultivated in gardens, that, on the contrary, there are several one-celled stones to the fruit, and that they adhere so slightly to each other that they can always be separated without injury.

[2] Rarely do we find both the ovules of one cell become fertile seeds.

[3] *Mespilus* T., *Instit.*, 641, t. 410.—L., *Gen.*, n. 625 (ex part.).—ADANS., *Fam. des Pl.*, ii. 296.—J., *Gen.*, 335.—GÆRTN., *Fruct.*, ii. 43, t. 87.—LINDL., *Trans. Linn. Soc.*, xiii. 99.—DC., *Prodr.*, ii. 633.—SPACH, *Suit. à Buffon*, ii. 51 (ex part.).—ENDL., *Gen.*, n. 6344.—*Mespilophora* NECK., *Elem.*, n. 724.

[4] This eye is only the opening of the receptacle. The axial nature of this latter organ is no longer contested, nor is it now admitted to be the basilar part of the calyx welded with the ovaries. In the common Medlar we have often seen a bract, analogous to the sepals, inserted at a variable height on the outside of this pouch. The receptacle constantly bears at least a couple of these bracts in *C. tanacetifolia* PERS. (see BRANDZA, in *Adansonia*, v. ii. 306.)

[5] The fruit of the Medlar is a turbinate drupe, depressed at the top into a large broad cupuliform eye, on the edges of which persist the five leafy sepals, separated by large triangular surfaces, which correspond with the insertion of the petals (TURP., *Dict. Sc. Nat.*, t. 243). The stamens are also represented within the perianth by a coronet of little blackish withered filaments. In front of each sepal is a groove, which goes to meet its fellows in the centre of the cupule, and gives passage to the blackish apiculate filiform remains of a withered style. The epicarp of the drupe is membranous and nearly glabrous, but with little rugose points scattered over its surface. The mesocarp, at first rather hard and acrid, becomes sweet and pulpy when bletted, and forms pretty thick septa between the five oppositipetalous stones. The walls of these are very thick and bony; they contain an ascending seed, like that of the Hawthorn; their internal angles are traversed by a slight longitudinal furrow.

[6] DC., *Prodr.*, ii. 626, 633.—GREN. & GODR., *Fl. de Fr.*, i. 567.—BOISS., *Esp.*, t. 61.—ROXB., *Fl. Ind.*, ii. 509, 510.—KOCH, *Ann. Mus. Lugd. Bat.*, i. 249.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 40.—H. B. K., *Nov. Gen. et Spec.*, vi. 168, t. 555.—TORR. & GR., *Fl. N. Amer.*, i. 463.—A. GRAY, *Man. of Bot.*, ed. v., 160.—CHAPM., *Fl. S. Unit.-States*, 126.—*Bot. Reg.*, t. 1852, 1860, 1877, 1884, 1885.—*Bot. Mag.*, t. 3432.—WALP., *Rep.*, ii. 57, 915; v. 661; *Ann.*, i. 288, 292; ii. 523; iii. 858.

[7] Their branches, especially those in the axils of last year's leaves, are often transformed into simple bi- or trifurcate spines.

Medlar solitary, in the rest of the genus grouped into either short racemes or corymbs, simple or composed of cymes. The different axes of the inflorescence arise from the axils of bracts of successive ages.

Cotoneaster[1] differs essentially from *Pyrus* and *Cratægus* in the insertion of the carpels. Of these there are five, or more frequently two or three, sometimes only one. They are free from each other, and touch, without adhering, by the ventral angles of their ovaries. But the base of each ovary, instead of being horizontal, is sliced off obliquely upwards and outwards, so that there is a broad surface of insertion, applied not towards the bottom of the floral receptacle, but over a large surface of the inside of the sac (fig. 466). Thus, the ovary is not very deep at the back, but much deeper on the ventral angle. Within, and near the base of this angle, are inserted two collateral descending anatropous ovules, with their micropyles downwards and outwards.[2] The styles are free, of the same number as the carpels, either diverging or close together, and each ending in a stigmatiferous head. On the edges of the receptacular sac are inserted the perianth and androceum, and the interval between their insertion and that of the ovaries is lined by a coloured glandular disk. The sepals are quincuncial, the petals imbricated. The stamens are about twenty in number, arranged as in *Pyrus*.[3] The fruit of *Cotoneaster* is a drupe consisting of from one to five stones imbedded in a fleshy receptacle.[4] In each is an ascending seed, whose exalbuminous embryo has its radicle superior. About fifteen species of this genus are known, shrubs or small

Cotoneaster thymifolia.

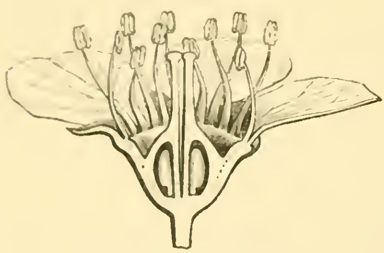

FIG. 466.
Longitudinal section of flower.

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[1] MEDIK., *Pflanz. Geschl.*, 1793.—LINDL., *Trans. Linn. Soc.*. xiii. 101, t. 9. — DC., *Prodr.*, ii. 632.—SPACH, *Suit. à Buffon*, ii. 73.—ENDL., *Gen.*, n. 6347.—PAYER, *Organog.*, 498, t. ccii. figs. 22-34.—B. H., *Gen.*, 627, n. 65.

[2] They have two coats.

[3] There are, however, species with but fifteen stamens, which may be arranged in two different ways, either in threes superposed to the petals, and none to the sepals, as in *C. tomentosa* LINDL., or two stamens superposed to each petal, and one to each sepal.

[4] Usually, indeed, this organ, together with the base of the calyx, is the only one to acquire this consistency in the fruit, for the ovaries form little woody nuts, surmounted by the withered style, and present no trace of fleshy tissue above where they project into the sac-like cavity formed by the upper part of the receptacle. The stone is thin in *C. denticulata* H.B. K. (*Nagelia* LINDL., *Bot. Reg.* (1845), *Misc.*, 40).

trees, erect or bushy. The leaves are alternate and simple; the two sepals are often persistent. The flowers are in cymes, often uniparous by exhaustion, rarely reduced to a single flower. Two species are European [1] The others come from Central and Northern Asia, and Northern Africa, some even from Mexico.[2]

The flowers of the Loquat[3] (Fr., *Bibacier*) are closely analogous to those of the preceding genera, especially *Cratægus;* but the endocarp is thin, as in *Pyrus* and *Cydonia.* Thus, in the prototype species, commonly known as the Japan Medlar[4] (Fr., *Néflier du Japon*), the calyx, corolla, and gynæceum are pentamerous.[5] The receptacle is campanulate, and the ovaries fill up the whole of the bottom of its cavity. Their upper surfaces form a concave cup, lined with glandular tissue continued as far as the edges of the receptacle. These edges bear five quincuncial sepals, five alternating caducous unguiculate imbricated petals, and a score of stamens, arranged as in the Pear, with free filaments inflexed in the bud, and introrse two-celled anthers dehiscing longitudinally. Each ovary contains two ovules like those of the Pear,[6] with their micropyles capped by an obturator, and is surmounted by a free style, dilated and stigmatiferous at the tip. The fruit is pretty similar to an apple; it is a nearly globular drupe, with an eye on top surrounded by the persistent sepals, while its thick flesh envelopes five cartilaginous stones, either all very thin, or some fertile and containing one or two erect seeds, with a fleshy exalbuminous embryo.

But from this plant we cannot logically separate *Photinia*,[7] which possesses smaller drupes, while its ovary and fruit contain five, four, or fewer cells, while all its other characters are absolutely identical. Thus the genus *Eriobotrya* contains about twenty species[8] from

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[1] *C. vulgaris* LINDL. (*Mespilus Cotoneaster* L., *Spec.*, 686) and *tomentosa* LINDL. (*M. tomentosa* W., *Spec.*, ii. 1012 (nec LAMK.);—*M. eriocarpa* DC., *Fl. Fr.*, Suppl., n. 3691).

[2] H. B. K., *Nov. Gen. et Spec.*, vi. 169, t. 556.—KOCH, *Ann. Mus. Lugd. Bat.*, i. 249.—WIGHT, *Icon.*, t. 992.—*Bot. Reg.*, t. 1187, 1229, 1305.—*Bot. Mag.*, t. 3519.—WALP., *Rep.*, ii. 56; v. 661; *Ann.*, i. 287; ii. 523.

[3] *Eriobotrya* LINDL., *Trans. Linn. Soc.*, xiii. 102 (part.).—DC., *Prodr.*, ii. 631.—SPACH, *Suit. à Buffon*, ii. 81.—ENDL., *Gen.*, n. 6349.

[4] *E. japonica* LINDL., *loc. cit.*—*Mespilus japonica* THUNBG., *Fl. Jap.*, 206.—*Cratægus Bibas* LOUR., *Fl. Cochinch.*, éd. i. (1790), 319.

[5] We frequently find 4-6-merous flowers in plants cultivated in gardens in the South of France.

[6] They have two coats.

[7] LINDL., *Trans. Linn. Soc.*, xiii. 103, t. 10.—DC., *Prodr.*, ii. 631.—SPACH, *Suit. à Buffon*, ii. 79.—ENDL., *Gen.*, n. 6350.—B. H., *Gen.*, 627, n. 66.—*Myriomala* LINDL., *Bot. Reg.*, n. 1956.

[8] SIEB. & ZUCC., *Fl. Jap.*, i. t. 97.—KOCH, *Ann. Mus. Lugd. Bat.*, i. 250.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 41; *Fl. Ind.-Bat.*, i. p. 1, 387.—BENTH., *Fl. Hongk.*, 107.—WIGHT, *Icon.*, t. 226, 228, 991; *Ill.*, t. 86.—TORR. & GR., *Fl. N. Amer.*, i. 472.—SEEM., *Bot. Her.*, 376.—WALP., *Rep.*, ii. 56; *Ann.*, iii. 858; iv. 670.

India, China, and North America, glabrous or hairy trees or shrubs, with persistent alternate simple leaves, possessing two lateral stipules,[1] and flowers in pseudo-corymbs,[2] or terminal ramified racemes, composed of usually biparous cymes.

Stranvæsia[3] differs very little in flower and vegetative organs from most species of *Eriobotrya* or *Photinia.* The perianth and androceum, too, are the same, but the ovary, usually five-celled, is always free for a pretty large extent, and finally forms with the surrounding receptacle a drupe with a crustaceous endocarp, also five-celled. When this fruit is quite ripe each cell opens down the middle line and separates from the central axis. The seeds then become quite free: they have tough coats surrounding a large fleshy embryo, with its radicle inferior and exserted. This genus consists of a single species,[4] a tree from the temperate parts of India possessing simple alternate leaves. Its habit and inflorescence are those of many species of *Photinia*, to which genus it might perhaps be referred merely as a section.

Raphiolepis[5] (figs. 467, 468) comes very near the preceding genera, from which it only differs essentially in the structure of its fruit and the way the upper part of the flower falls off after anthesis. The floral receptacle is like an elongated cornet or funnel, of which the bottom is filled up by the ovary. Above this, it is lined by a coloured glandular disk, which does not reach its mouth, where the perianth and androceum are inserted. The calyx consists of five quincuncial sepals, and the corolla of as many elongated unguiculate petals, usually twisted in æstivation. The androceum has often twenty stamens, and

Raphiolepis rubra.

FIG. 467.
Flower.

FIG. 468.
Longitudinal section of flower.

[1] The stipules are sometimes very large, broad, and leafy.

[2] Really formed of cymes, with axes of three or four successive generations.

[3] LINDL., *Bot. Reg.*, t. 1956.—ENDL., *Gen.*, n. 6351.—B. H., *Gen.*, 627, n. 68.—WALP., *Rep.*, ii. 59.

[4] *S. glauca.*—*S. glaucescens* LINDL., *loc. cit.*—*Cratægus glauca* WALL., *Cat.*, n. 673.—BENTHAM & HOOKER refer with doubt to the genus *Photinia S. digyna* SIEB. & ZUCC., (*Abh. d. Akad. Wiss.*, iv. 2, 129.—WALP., *Ann.*, i. 973).

[5] LINDL., *Bot. Reg.*, t. 468, 652, 1400; *Collect. Bot.*, t. 3; *Trans. Linn. Soc.*, xiii. 105.—DC., *Prodr.*, ii. 630.—SPACH, *Suit. à Buffon*, ii. 78.—ENDL., *Gen.*, n. 6352.—B. H., *Gen.*, 627, n. 67.

sometimes more. In the former case, five will be exactly superposed to the midribs of the petals, and as many to the midribs of the sepals: while the ten others will alternate with them. Each consists of a free filament, inflexed in the bud, and an introrse two-celled anther. The gynæceum consists of a syncarpous inferior two-celled ovary surmounted by a single style, which soon divides into two branches, each swollen at the end into a stigmatiferous head. Towards the base of the internal angle of each cell are inserted two descending ovules with their micropyles downwards and outwards.[1] The fruit is a berry,[2] formed by the ovary and the lower part of the receptacular sac, which persists around it, while the upper part comes off after fecundation in a circular piece, as in several *Monimiaceæ*, bringing with it the withered calyx and androceum. There is generally only one ascending seed, whose large embryo[3] has hemispherical fleshy cotyledons. The genus *Raphiolepis* consists of about four or five known species, trees and shrubs from the east of Asia.[4] Their simple, persistent, alternate, petiolate leaves, each with its two lateral stipules, come very near those of the Pears. Their flowers are in axillary or terminal simple or ramified racemes, bearing little alternate caducous bracts, axillary to which are the flowers, either solitary or in small cymes.

Amelanchier[5] approaches at once *Pyrus*, *Cratægus*, and *Raphiolepis*, possessing nearly the flower of the two former species, and the wholly fleshy fruits of the latter. The sepals and petals are five in number, and the androceum is that of most *Pyreæ*. But the gynæceum and fruit present peculiar features to which too great importance has perhaps been assigned. The number of carpels varies from two to five, as in *Eriobotrya*, *Cotoneaster*, &c., and the ovary is wholly or partially inferior. In each ovary are found two collateral ovules, ascending as in the above genera; but between these its wall projects to a variable extent[6] so as to form an incomplete chamberlet

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[1] They have also two coats.

[2] The flesh is generally pulpy and quite white, whereas the epicarp alone is reddish, violet, or blackish, the tint varying in depth.

[3] In certain species it is of a beautiful green colour.

[4] LINDL., *loc. cit.*—WALP., *Rep.*, ii. 57.—SIEB. & ZUCC., *Fl. Jap.*, t. 85.—HOOK., *Bot. Mag.*, t. 5510.—KOCH, *Ann. Mus. Lugd. Bat.*, i. 250.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 41; *Fl. Ind.-Bat.*, i. p. 1, 388.—BENTH., *Fl. Hongk.*, 107.—SEEM., *Bot. Her.*, 376.

[5] *Amelanchier* MEDIK., *Pflanz. Geschl.* (1703).—MŒNCH, *Meth.*, 682.—LINDL., *Trans. Linn. Soc.*, xiii. 100.—DC., *Prodr.*, ii. 632.—SPACH, *Suit. à Buffon*, ii. 82.—ENDL., *Gen.*, n. 6345.—B. H., *Gen.*, 628, n. 70.—*Aronia* PERS., *Syn.*, ii. 39.—*Peraphyllum* NUTT., ex TORR. & GR., *Fl. N. Amer.*, i. 474.

[6] Sometimes very slightly, so that this character has but very little value, especially as botanists are by no means agreed in placing in a distinct genus (*Nagelia*) those species of *Cotoneaster* which, like *C. denticulata*, H. B. K., have

for each ovule, and later, for each seed. Hence the fruit (either altogether fleshy, or provided with a membranous or parchment-like endocarp), is divided into twice as many one-seeded incomplete divisions as there are remains of withered styles at its apex. The genus consists of three or four species of shrubs or bushes from the south of Europe, the East, Japan, and North America.[1] The leaves are alternate simple and caducous, often downy; the petiole may or may not possess two lateral stipules. The flowers are axillary to narrow caducous bracts, and form corymbose or elongated cymes.

Osteomeles[2] also possesses the perianth and androceum of the preceding genera. The gynæceum consists of five carpels which are externally just like those of *Cratægus* or *Mespilus*. But each ovary only contains a single ovule, nearly erect, with its micropyle outwards and downwards. The fruit is a drupe containing five one-seeded stones, either separate, or in contact and cohering to one another. The genus *Osteomeles* consists of trees or shrubs with alternate stipulate leaves, and flowers in simple or compound corymbs. About half a dozen species from the Andes of Central America[3] have been designated under the special name of *Hesperomeles*,[4] and are easily distinguished by their simple leaves from the prototype of the genus *Osteomeles*,[5] a native of the Sandwich Islands possessing pinnate leaves, but not differing in flower or fruit.

Finally, in the perianth and androceum of *Chamæmeles*,[6] we find all the floral characters of *Cratægus*. But in the bottom of its concave receptacle is seen only one carpel whose ovary, free only in its upper part, bears a vertical groove up one side, continued the whole length of the style. Corresponding with this groove, inside the one-celled ovary, is a parietal placenta, towards the base of which are inserted two nearly erect collateral ovules, whose raphes look

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a thin endocarp and the ovary-cells subdivided by false dissepiments (see p. 398, note 4). There are, on the contrary, plants which, like the Fiery Thorn (*Cratægus pyracantha* PERS., Fr., *Buisson-ardent*), are nearly inseparable from any of the three genera *Cratægus*, *Amelanchier*, or *Cotoneaster*.

[1] LINDL., *Bot. Reg.*, t. 1171, 1589.—SIEB. & ZUCC., *Fl. Jap.*, t. 42.—MIQ., *Ann. Mus. Lugd. Bat.*, iii. 41.—TORR. & GR., *Fl. N. Amer.*, i. 473.—A. GRAY, *Man. of Bot.*, ed. v. 162.—CHAPM., *Fl. S. Unit.-States*, 129.—GREN. & GODR., *Fl. de Fr.*, i. 575.—WALP., *Rep.*, ii. 55; v. 660; *Ann.*, ii. 522

[2] LINDL., *Trans. Linn. Soc.*, xiii. 98, t. 8.—DC., *Prodr.*, ii. 633.—ENDL., *Gen.*, n. 6343.—B. H., *Gen.*, 628, n. 71.—*Eleutherocarpum* SCHLTL., *exs. Peruv. Lechl.*, n. 2060.

[3] H. B. K., *Nov. Gen. et Spec.*, vi. 166, t. 553, 554.—WEDD., *Chlor. And.*, ii. 229.—HOOK., *Icon.*, t. 846.—WALP., *Rep.*, ii. 56; *Ann.*, iv. 670.

[4] LINDL., *Bot. Mag.*, n. 1956.—ENDL., *Gen.*, n. 6348.

[5] *O. anthyllidifolia* LINDL., *loc. cit.*—*Pyrus anthyllidifolia* SMITH, *Rees Cyclop.*, n. 29.

[6] LINDL., *Trans. Linn. Soc.*, xiii. 104, t. 11.—DC., *Prodr.*, ii. 631.—ENDL., *Gen.*, n. 6351.—B. H., *Gen.*, 628, n. 69.

towards the placenta. The fruit is a one-celled one-seeded drupe, crowned by the remains of the calyx and androceum. Till quite recently the only known species of this genus was a Madeiran shrub,[1] with alternate crowded simple petiolate leaves possessing two caducous stipules, and with the flowers in axillary and terminal racemes. We may hence consider *Chamæmeles* as a unicarpellary *Cratægus*, which by the degeneration of its gynæceum becomes analogous to the Alchemils and Burnets among the *Agrimonieæ*, *Cercocarpus* and *Purshia* among the *Fragarieæ*, or *Stephanandra* among the *Spireeæ*, also thus forming a transition between *Pyreæ* and the principal genus of the Plum series.

VII. PLUM SERIES.

In the Plum genus[2] (Fr., *Prunier*—figs. 468–483) we find regular

Prunus Amygdalus (*Almond*).

FIG. 469.
Leaf-bearing branch.

FIG. 470.
Flower-bearing branch.

hermaphrodite flowers.[3] The receptacle is more or less concave,

[1] *C. coriacea* LINDL., *loc. cit.*—LOWE, *Fl. Mader.*, 255. We have recently described a second species of American origin, *C. mexicana* (*Adansonia*, ix. 148, n. 20), which, with a very different foliage, and covered with a pretty copious rust-coloured down, has, however, exactly the flowers of the Madeira species. The petals are contorted, and the inflorescence is a panicle of cymes terminating the young branches.

[2] *Prunus* T., *Instit.*, 622, t. 398.—L., *Gen.*, n. 620.—ADANS., *Fam. des Pl.*, ii. 305.—J., *Gen.*, 341.—GÆRTN., *Fruct.*, ii. 74, t. 93.—LAMK., *Dict.*, v. 663; Suppl., iv., 583; *Ill.*, t. 432.—DC., *Prodr.*, ii. 532.—SPACH, *Suit. à Buffon*, i. 391.—ENDL., *Gen.*, n. 6046.—B. H., *Gen.*, 609, n. 13 (incl. *Prunophora* NECK., *Armeniaca* T., *Persica* T., *Amygdalus* T., *Amygdalophora* NECK., *Cerasus* J., *Laurocerasus* T., *Cerasophora* NECK., *Ceraseidos* SIEB. & ZUCC., *Emplectocladus* TORR.).

[3] Or exceptionally polygamous by abortion of the gynæceum.

forming a short cup, sac, or tube. On its edges are inserted the calyx formed of five[1] sepals, quincuncially imbricated in the bud, and the corolla, whose petals are arranged and imbricated as in the Roses. The stamens are inserted a little lower down than the

Prunus Amygdalus.

FIG. 471.
Flower.

FIG. 472.
Longitudinal section of flower.

perianth, above the rim of a glandular, often coloured disk lining the whole inside of the receptacle. They are often twenty in number: five superposed to the sepals, five to the petals, and ten placed one on either side of each of the latter.[2] Each consists of a free filament inflexed in the bud, and an introrse two-celled anther dehiscing longitudinally. The unicarpellary gynæceum,[3] inserted in the bottom of the receptacle, consists of a one-celled ovary superposed to a sepal, surmounted by a terminal style, dilated at the tip into a stigmatiferous head. A vertical groove runs along the whole of the style and ovary, answering to where the cavity of the latter bears a parietal placenta, on which are inserted two collateral descending anatropous ovules, with their micropyles superior,

FIG. 473.
Seed.

FIG. 474.
Embryo.

[1] There are often hexandrous flowers in several species of the section *Amygdalus*, but there are rarely tetramerous flowers.

[2] There are pretty often thirty in *Amygdalus* and *Cerasus*, each petal having five instead of three in front of it. The androceum is always what we have termed for shortness' sake an "androceum of the *Rosaceæ*." In the flowers of the common Almond, with thirty stamens, we first find two, the largest of all, in front of each petal, and then a third alternate with these. The fourth and fifth are superposed to the first two, and are the youngest and smallest of all, including even those superposed to the sepals.

[3] We often, however, find abnormal flowers in *Prunus*, inclosing two or more free carpels (figs.

and exterior or dorsal, capped by obturators formed by the thickened placenta.[1] The fruit is a drupe, at the base of which is seen the scar of the receptacle and calyx. In *Prunus* proper, the epicarp of

Prunus Padus (*Bird Cherry*).

Fig. 477.
Inflorescence.

Prunus Mahaleb.

Fig. 478.
Inflorescence.

this drupe is glabrous, often covered with a whitish bloom; the mesocarp is thin and fleshy. The endocarp forms a compressed ovoidal

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475, 476), thus becoming analogous to those of *Nuttallia* or several *Spireeæ* or *Quillajeæ*. Sometimes these carpels are formed like the normal

Fig. 475.

ones, and possess a biovulate ovary; sometimes as in the double Cherries of our gardens, they are more or less leaf-like, opened out and hypertrophied. The same thing often occurs in the little flowering Plum-trees of our parterres, especially *P. triloba* Lindl. Hence Carrière (*Rev. Hortic.* (1862), 91, Icon.) proposed the

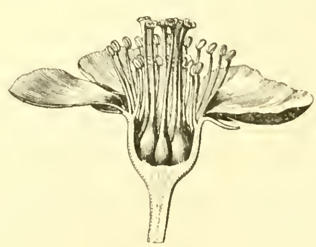

Fig. 476.

genus *Amygdalopsis* ("*est forma monstrosa inepte pro genere habita*," B. H., *Gen.*, 610).

[1] The ovules have two coats; above them the placenta forms two more or less prominent and

or elongated stone, with a smooth or wrinkled surface, containing one or two descending seeds. enclosing in their coats a large fleshy exalbuminous[1] embryo. *Prunus* proper consists of trees or shrubs from the temperate regions of the northern hemisphere, with alternate simple petiolate leaves, at whose bases are two lateral stipules; the blade is convolute in the bud. The flowers arise before or at the same time as the buds; they are solitary, in pairs, or in short few-flowered racemes, usually evolved from scaly buds.[2] About a score of species are known.[3]

In the genus *Prunus*, botanists are generally agreed in including as so many sections the following types, which are sometimes considered as distinct genera.

1. The Apricots[4] (Fr., *Abricotiers*) possess a short rather broad floral receptacle, and a fruit with a velvety epicarp, pulpy flesh, and a smooth or wrinkled stone with a longitudinal groove down each edge. Here, too, the leaves are convolute in præfoliation, and the flowers, pedicellate or subsessile, come out before the leaves from the scaly buds which protected them during the winter. The two or three known species are natives of temperate Asia, except one which comes from America.[5]

2. The Peaches[6] (Fr., *Pêchers*—fig. 479) have a more or less elongated, sometimes tubular, receptacle. The fruit is velvety on the surface, with a more or less fleshy succulent mesocarp, and a very hard stone much wrinkled on the surface. The vernation of the leaves[7] is conduplicate (fig. 479), and the flowers behave like those

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papillate longitudinal lips. In certain Almond flowers we have seen these bearing two supplementary ovules above the normal ones, each surmounted by a vertical process of the placenta (*Adansonia*, ix. 152, t. iii. fig. 2).

[1] That is, when adult, for we may say that the albumen is double, as in *Nymphæa*, at an earlier age. In cultivation we not unfrequently find embryos of *Prunus* with three equal or unequal cotyledons.

[2] Usually a little before.

[3] SER., DC., *op. cit.*, 532.—DC., *Fl. Fr.*, iv. 483.—GREN. & GODR., *Fl. de Fr.*, i. 513.—LEDEB., *Ic. Fl. Ross.*, t. 13.—SPACH, *op. cit.*, 392.—LOUR., *Fl. Cochinch.*, ed. 1790, 317.—ROXB., *Fl. Ind.*, ii. 500.—MIQ., *Fl. Ind.-Bat.*, i. p. 1, 363.—TORR. & GR., *Fl. N. Amer.*, i. 406.—A. GRAY, *Man. of Bot.*, ed. v. 147; *Proceed. Amer. Acad.*, vii. 337.—CHAPM., *Fl. S. Unit.-States*, 119.—H. B. K., *Nov. Gen. et Spec.*, vi. 190, t. 563.—C. GAY, *Fl. Chil.*, ii. 262.—WALP., *Rep.*, ii. 8; *Ann.*, ii. 272; iv. 651.

[4] *Armeniaca* T., *op. cit.*, 623, t. 399.—J., *Gen.*, 341.—LAMK., *Dict.*, i. 1.—DC., *op. cit.*, 531.—SPACH, *op. cit.*, 388.

[5] DC., *loc. cit.*—LINDL., *Bot. Reg.*, t. 1243.—C. GAY, *Fl. Chil.*, 263.—WALP., *Ann.*, ii. 464.—LAMK., *Dict.*, i. 98.

[6] *Persica* T., *op. cit.*, 624, t. 400.—LAMK., *Dict.*, i. 98; Suppl., iv. 336.—DC., *op. cit.*, 531.—SPACH, *op. cit.*, 379.—*Trichocarpus* NECK., *Elem.*, n. 718.

[7] These are provided with glands in this section, usually better developed than in any of the others of this genus. Some occupy the apices of the teeth of the limb, while others, much larger, are borne on the sides of the top of the petiole (fig. 479).

of the Apricots towards the end of the winter. A couple of species are known, natives of temperate Asia.[1]

3. The Almonds[2] (Fr., *Amandiers*—figs. 469–474) have all the characters of the Peaches as regards leaves, inflorescence. and flower-

Prunus Persica (Peach).

Fig. 479.
Branch.

ing. But the stone, of variable thickness and sometimes very hard, is scarcely wrinkled on the surface, which is riddled by narrow pores; the mesocarp, at first fleshy or leathery, but thick, finally becomes dry like the velvety epicarp to which it remains intimately united. This little group comprises about eight species from Asia and the south of Europe.[3]

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[1] Mill., *Dict.*, n. 1.—DC., *Fl. Fr.*, iv. 487.—Lamk., *Dict.*, i. 100, n. 1–42.

[2] *Amygdalus* T., *op. cit.*, 627, t. 402.—L., *Gen.*, n. 619.—J., *Gen.*, 341.—Lamk., *Dict.*, i. 102; Suppl., i. 309.—Gærtn., *Fruct.*, ii. 74, t. 93.—DC., *op. cit.*, 530.—Spach, *op. cit.*, 385.—Endl., *Gen.*, n. 6405.—*Amygdalophora* Neck., *Elem.*, n. 717.

[3] DC., *loc. cit.*—Spach, *Ann. Sc. Nat.*, sér. 2, xix. 106.—Jaub. & Spach, *Ill. Pl. Orient.*, iii.

4. The Cherries[1] (Fr., *Cerisiers*—figs. 480–482) have a floral receptacle of very variable form, a drupe, whose smooth epicarp has no waxy bloom, while the mesocarp is more or less fleshy or fibrous, and the stone is smooth or more rarely wrinkled. The leaves are

Prunus Cerasus (*Cherry*).

FIG. 480.
Inflorescence.

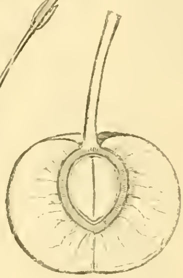

FIG. 482.
Longitudinal section of fruit.

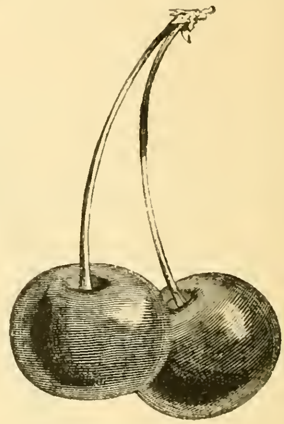

FIG. 481.
Fruit.

conduplicate in the buds, the flowers which arise before the leaves or at the same time with them are in umbels or short racemes. The northern hemisphere of both Worlds contains from fifteen to twenty species.[2]

5. The Cherry Laurels[3] (Fr., *Lauriers-Cerises*—fig. 483) have a short obconical receptacle. The drupes, often not over fleshy, have a smooth epicarp, naked or covered with a waxy bloom, and a

t. 226–230.—*Bot. Reg.* (1839), t. 18.—GREN. & GODR., *Fl. de Fr.*, i. 512.—ROXB., *Fl. Ind.*, ii. 499.—MIQ., *Fl. Ind.-Bat.*, i. p. 1, 362.—LOUR., *Fl. Cochinch.*, éd. 1790, 315.—C. GAY, *Fl. Chil.*, ii. 258.—H. B. K., *Nov. Gen. et Spec.*, vi. 191, t. 561.—WALP., *Rep.*, ii. 8, 907; *Ann.*, i. 271; iv. 650.

[1] *Cerasus* T., *loc. cit.*, 625, t. 401.—J., *Gen.*, 340.—LAMK., *Dict.*, i. 686; v. 668.—SER., DC., *op. cit.*, 535.—*Cerasophora* NECK., *Elem.*, n. 720.

[2] DC., *Fl. Fr.*, iv. 479.—GREN. & GODR., *Fl. de Fr.*, i. 515.—SPACH, *op. cit.*, 400.—WALL., *Pl. As. Rar.*, t. 143.—LINDL., *Bot. Reg.*, t. 1801.—C. GAY, *Fl. Chil.*, ii. 265.—WALP., *Rep.*, ii. 9; *Ann.*, i. 272; ii. 465 (part.); iv. 651.

[3] *Laurocerasus* T., *Inst.*, 627, t. 403.—*Padus* MILL., ex ENDL., *loc. cit.*, β.

spherical or elongated, smooth or wrinkled stone. The leaves are conduplicate in vernation, and the flowers arranged in more or less elongated axillary or terminal racemes. There are about a score and a half of species in the warm and temperate regions of both Worlds, especially America.[1]

In all the preceding sections of the genus *Prunus* we find species which present variations in the number of pieces in the flower.

Prunus Laurocerasus (*Cherry Laurel*).

Fig. 483.
Branch.

We rarely find a tetramerous or hexamerous perianth. The petals again are rarely quite absent, as in *Ceraseidos*.[2] The number of stamens may be higher than twenty, and we often find twenty-five, thirty, or even more. Other flowers have only fifteen, and rarely less.

[1] Ser., DC., *op. cit.*, 539.—Spach, *op. cit.*, 412.—H. B. K., *Nov. Gen. et Spec.*, vi. t. 563.—Wall., *op. cit.*, t. 181.—Hook., *Beech. Voy.*, t. 83; *Icon.*, t. 371; *Bot. Mag.*, t. 3141.—Jacq., *Fl. Austr.*, t. 227.—Gren. & Godr., *op. cit.*, 516.—Webb, *Phyt. Canar.*, t. 38.—Walp., *Rep.*, ii. 10; v. 648; *Ann.*, iv. 652.

[2] Sieb. & Zucc., *Abhandl. Münch. Akad.*, iii. 743, t. 5, fig. ii.

This is the case with *Emplectocladus*,[1] which was placed with some doubt in *Spireæ*, for there are sometimes twelve or thirteen stamens, but usually only ten superposed to the leaves of the perianth, which is that of the Plums; the floral receptacle is short and rather large, lined by a thin glandular disk, except towards its upper edge. The short gynæceum is also that of *Prunus;* in the ovary are two collateral descending ovules, with their micropyles upwards and outwards, each capped by a cellular obturator. The only known species is a Californian shrub, with thick rigid branches, in aspect like certain little wild Almonds. Its little crowded leaves possess two lateral stipules, and the flowers are sessile, solitary or geminate.

Thus limited and divided into eight sections,[2] not always sharply marked off, the genus *Prunus* consists of about eighty species, all woody, with alternate stipulate simple leaves, and nearly all natives of the temperate regions of the northern hemisphere; none is found spontaneous in Oceania, tropical or southern Africa, or the southern extremity of South America.

The flowers of *Pygeum*[3] are altogether analogous to those of *Prunus* in the receptacle, the disk lining it, the insertion of the androceum and gynæceum. But the perianth presents pretty well-marked differences. The caducous calyx consists of from five to fifteen little leaves, imbricated in æstivation. The petals are ill-developed, in form and consistency like the sepals, instead of being large and membranous as in *Prunus*. There are from twenty to thirty stamens arranged as in *Prunus;* each consists of an inflexed filament and an introrse didymous anther, at first lodged in the very bottom of the receptacle owing to the inflexion of its filament, afterwards raised up and considerably exserted. The fruit is drupaceous, or dry and coriaceous, often transversely elongated, as is the single seed it contains, whose exalbuminous embryo has thick fleshy cotyledons and a short superior radicle. The genus

[1] TORR., *Plant. Fremont.*, 10, t. v.—B. H., *Gen.*, 614, n. 27. The only known species (*E. ramosissimus* TORR.) is in foliage and floral organization closely analogous to *Amygdalus microphylla* H. B. K.

[2] *Prunus.*

Sections 8.
1. *Prunophora* (NECK.).
2. *Armeniaca* (T.).
3. *Persica* (T.).
4. *Amygdalus* (T.).

Sections 8 (*continued*).
5. *Emplectocladus* (TORR.)
6. *Cerasus* (T.).
7. *Laurocerasus* (T.).
8. *Ceraseidos* (SIEB. & ZUCC.).

[3] GÆRTN., *Fruct.*, i. 218, t. 46.—ENDL., *Gen.*, n. 6404.—B. H., *Gen.*, 610, n. 16.—*Polydontia* BL., *Bijdr.*, 1104.—*Polystorthia* BL., *Fl. Jav. Præf.*, viii.—*Germaria* PRESL., *Epimel.*, 221.—*Digaster* MIQ., *Fl. Ind.-Bat.*, Suppl., 329, 619.

consists of trees or shrubs from tropical Asia and Malaysia. Of the ten species known,[1] one comes from the east of tropical Asia; they have alternate persistent, entire petiolate leaves, accompanied by two lateral caducous stipules. The flowers are in axillary or lateral racemes, simple or made up of little cymes.

Maddenia[2] is also closely analogous to *Prunus* and *Pygeum*. The receptacle is funnel-shaped, and bears on its edges from five to ten unequal sepals and a variable number of leaves, more or less developed, which are considered as petals. The androceum is the same as in *Pygeum*, and is very well developed in certain flowers, with only one carpel to the gynæceum resembling that of *Prunus*; while in other flowers, female or hermaphrodite, usually found on different stocks, there are two carpels, each formed of a stumpy ovary without a style, and bearing immediately on its summit an oblique layer of stigmatic papillæ. These last flowers produce a multiple fruit of two compressed glabrous drupes, in which the thick crustaceous stone is smooth on one side, three-keeled on the other, and contains a seed with a fleshy exalbuminous embryo. The only known species of *Maddenia* is a small tree from the Himalayas,[3] whose branches, covered with a thick rusty down, bear simple alternate leaves, with glandular teeth, and two large glandular petiolar stipules. The flowers are in terminal racemes.

Prinsepia[4] (figs. 484, 485) has regular hermaphrodite flowers. The receptacle forms a large nearly hemispherical cup on whose edges are inserted five unequal sepals, quincuncially imbricated in the bud, and as many alternate subunguiculate petals, also imbricated in the bud, but afterwards broad and spreading. The stamens, from fifteen to thirty in number, are also borne on the rim of the same cup, and consist of a free filament, at first inflexed, and an introrse two-celled anther dehiscing longitudinally. In the bottom of the cup is inserted the gynæceum, consisting of a one-celled ovary tapering into a style dilated at the tip into a little stigmatiferous head. The ovules are two in number, collateral and descending, with their raphes towards the placenta and the micropyles outwards, each

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[1] Colebr., *Trans. Linn. Soc.*, xii. 360, t. 18.—Wight, *Ill.*, i. 203; *Icon.*, t. 256, 993.—Miq., *Mus. Lugd. Bat.*, i. 212; *Fl. Ind. Bat.*, i. p. 1, 360.—Thw., *Enum. Pl. Zeyl.*, 103.—Benth., *Fl. Hongk.*, 103.—Walp., *Rep.*, ii. 8; *Ann.*, i. 271; iv. 641.

[2] Hook., F. & Thoms., *Hook. Journ.*, vi. 381, t. 12.—B. H., *Gen.*, 610, n. 14.

[3] *M. himalaica* Hook. F. & Thoms., *loc. cit.*—Walp., *Ann.*, iv. 649.

[4] Royle, *Illustr. Pl. Himal.*, 206, t. 38, fig. 1.—Endl., *Gen.*, n. 6414.—*Cycnia* Lindl. (nec Griff.), ex Endl., *loc. cit.*—B. H., *Gen.*, 611, n. 16.

capped by an obturator. The fruit is a drupe with the thickened receptacle and withered calyx around its base. The development of the pericarp has taken place to such an extent on one side during maturation, that the style has become lateral or even nearly basilar.[1] The stone contains an ascending seed whose oily fleshy exalbuminous

Prinsepia utilis.

FIG. 484.
Flower.

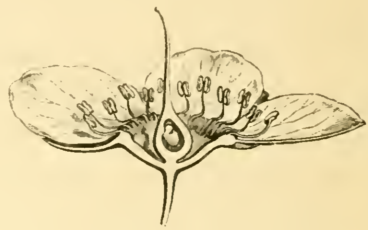

FIG. 485.
Longitudinal section of flower.

embryo has its radicle downwards. The only known species of *Prinsepia* is *P. utilis*,[2] a bushy shrub from the temperate regions of India, with alternate simple leaves possessing two caducous stipules. Its flowers are in axillary racemes, or are solitary axillary; each peduncle is accompanied by a spine which is really an abortive branch, and is frequently found bearing a few alternate bracts in the axils of the leaves of the non-floriferous branches.

Not without hesitation do we bring near *Prinsepia* the genus *Strephonema*,[3] which has been considered a doubtful Lythrariad. In fact its flowers seem to us to differ from those of the preceding genus solely in their ovary, which is free only in its upper part. The receptacle forms a cup bearing on its everted edges five sepals,[4] and as many alternate petals, both sets imbricated. The androceum is diplostemonous, and the free stamens, inserted more internally and lower down than the perianth, resemble those of *Prinsepia*. The one-celled ovary tapers above into a long style, also tapering to its stigmatiferous tip; and below the place where it becomes free from all adhesion with the receptacle, it contains on a parietal placenta two collateral curved amphitropous ovules, either descending, their micropyles near the hilum and looking towards the placenta, or more rarely

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[1] Hence this genus has nearly always been referred to the group *Chrysobalaneæ*. In fact, *Prinsepia* belongs to *Pruneæ* by its flowers, to *Chrysobalaneæ* by its fruit.

[2] *P. utilis* ROYLE, *loc. cit.*—WALP., *Rep.*, ii. 7.

[3] HOOK., F., *Gen.*, 782, n. 21?

[4] *S. Mannii* and *S. sericea* HOOK. F., *loc. cit.*

slightly ascending. No opportunity has as yet occurred for examining the fruit of either of the two known species; these are branching trees from the west of tropical Africa, glabrous or with silky down, and possessing opposite or alternate shortly petiolate simple coriaceous leaves. The flowers are on slender pedicels, and are grouped in simple or compound pseudo-corymbs on the wood of the branches or in the axils of the leaves.

The flowers of *Nuttallia*[1] are also in general organization those of *Prunus*,[2] and are polygamo-diœcious. In the female flowers, there are as many carpels as petals. The broad short receptacular tube lined by a layer of glandular tissue, comes off after fertilization in a circular piece, just as in *Raphiolepis*, bringing with it the perianth which is inserted on its edges, and which consists of five quincuncial sepals and as many alternate shortly unguiculate imbricated petals. We find fifteen stamens analogous to those of *Prunus*, and arranged in two whorls;[3] each possesses a free filament inflexed in the bud, and an introrse two-celled anther. This anther is sterile in the female flowers, in which the three, four, or five oppositipetalous carpels are inserted in the bottom of the receptacle. Each consists of an ovary with a contracted base surmounted by a style which articulates with it, and is dilated at the tip into a stigmatiferous head. In the ventral angle of the ovary is a placenta bearing two collateral descending ovules, whose micropyles are superior and exterior, and are capped by thick obturators. The fruit consists of one or more drupes, with coriaceous one-seeded endocarps. The descending seed contains within its membranous coats a little sheet of albumen. Only one species[4] of *Nuttallia* is known, a small tree from North America[5] with alternate caducous simple entire petiolate[6] exstipulate leaves. Its flowers are in pendulous racemes,[7] at first enveloped with the young branches in scaly buds.

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[1] TORR. & GR., *Fl. N. Amer.*, i. 412.—HOOK., *Bot. Beech. Voy.*, Suppl., 336, t. 82.—ENDL., *Gen.*, n. 6394.—B. H., *Gen.*, 611, n. 17.

[2] They are also, as we have said (p. 389, note 2), altogether the same externally as those of *Exochorda*, which possesses a totally different fruit. The foliage is pretty similar in the two genera.

[3] A. DICKSON (*Journ. of Bot.*, iv. (1866), t. lii. fig. 4) has observed that of the fifteen stamens of *N. cerasiformis* five are in front of the median lines of the petals, with ten larger than these, placed one on either side of each, so that there are no stamens superposed to the sepals; and according to his view of the androeceum in *Rosaceæ*, this plant has compound stamens, without any confluence of their lobes.

[4] *N. cerasiformis* TORR. & GR., *loc. cit.*—WALP., *Rep.*, v. 659.

[5] "*A grad. bor.* 35° *ad* 50° *vigens*."

[6] They are said to smell like prussic acid.

[7] Each flower, axillary to a bract, is accompanied by two lateral bractlets, placed at a variable height on its pedicel.

VIII. COCOA-PLUM SERIES.

a. *Gynæceum central.*

The Cocoa-plums[1] (Fr., *Icaquiers*—figs. 486–488) have hermaphrodite regular flowers. The receptacle forms a hollow inverted cone lined by a glandular disk. In the bottom of the cone is inserted the gynæceum, while its edges bear the androceum and perianth.

Chrysobalanus Icaco.

Fig. 486.
Habit ($\frac{2}{3}$).

The calyx consists of five free sepals quincuncially imbricated in the bud. The alternating petals are also imbricated in the bud, longer than the sepals, and caducous. The androceum consists of from fifteen to fifty stamens, arranged in whorls as in the Plums,[2] and

[1] *Chrysobalanus* L., *Gen.*, n. 621.—J., *Gen.*, 440.—Lamk., *Dict.*, iii. 224; Suppl., iii. 135; *Ill.*, t. 428.—Turp., *Dict. Sc. Nat.*, t. 236.—DC. *Prodr.*, ii. 525.—Spach, *Suit. à Buffon*, i. 369.—Endl., *Gen.*, n. 6407.—B. H., *Gen.*, 606, n. 1.—*Icaco* Plum., *Gen.*, 43, t. 5.

[2] It is impossible to make out this arrangement in the adult flowers with very numerous stamens

each composed of a filament, which may be free or slightly adherent to its neighbours, and a short introrse didymous anther dehiscing by two longitudinal clefts. There may be one or more stamens reduced to their filaments. The gynæceum consists of a unicarpellary one-celled ovary, superposed to a sepal,[1] and a gynobasic style stigmatiferous, but hardly, if at all, dilated at the apex. Near the base of the ovary is seen a placenta bearing two collateral ascending anatropous ovules, with their raphes looking towards the back of the cell, and their micropyles downwards and towards the insertion of the style. The receptacle, the calyx, and even the staminal filaments persist around the base of the fruit, which is a drupe whose adherent stone,[2] indehiscent or incompletely dehiscent at its base, contains a single ascending seed with membranous coats enclosing a large fleshy exalbuminous embryo, with its radical inferior. The Cocoa-plums are trees or shrubs with alternate simple entire leaves, possessing two lateral caducous stipules; their flowers are in axillary or terminal pedunculate cymes, usually biparous. One species, *C. oblongifolius*,[3] is a native of North America. The other species, *C. Icaco*,[4] is far better known, a native of the tropical

Chrysobalanus Icaco.

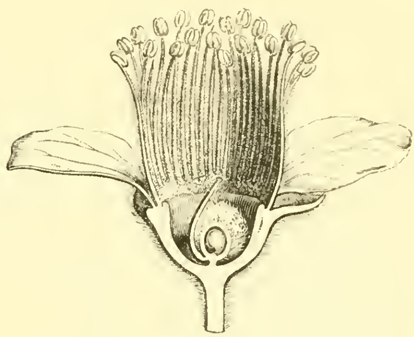

Fig. 487.
Longitudinal section of flower ($\frac{4}{1}$).

Chrysobalanus oblongifolius.

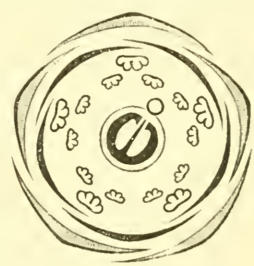

Fig. 488.
Diagram.

of *C. Icaco* L., but when there are only about fifteen stamens, as in *C. oblongifolius* Michx., we may easily see at every age that they are what we have termed "stamens of the *Rosaceæ*," and are not really "*uniseriata*," as several authors have supposed. In fact, of the fifteen stamens of *C. oblongifolius*, five are placed one in front of the middle line of each sepal, and the rest one on either side of each of these (fig. 488); but there is no oppositisepalous stamen. In this species their monadelphy is evident, though not very great. The pollen grains are, according to H. Mohl (*Ann. Sc. Nat.*, sér. 2, iii. 341), ovoidal or spherical in water, with three bands covered with large papillæ.

[1] Which is sepal No. 3 (fig. 488), as in all the other plants of this series that we have been able to examine from this point of view.

[2] It is angular, often traversed below by grooves of variable length and depth. The sarcocarp is said to become dry finally in certain species.

[3] Michx., *Fl. Bor. Amer.*, i. 285.—Nutt., *Gen. Amer.*, i. 301.—DC., *loc. cit.*, ii. 3.—Torr. & Gr., *Fl. N. Amer.*, i. 406.

[4] L., *Spec.*, 513.—Jacq., *Amer.*, 154, t. 94.—

regions of America and Africa, presenting several forms or varieties considered by some authors as sufficiently distinct species; but this opinion appears on the whole barely admissible.

Next to *Chrysobalanus*, come the plants which AUBLET named *Moquilea*.[1] The floral receptacle forms a sac far more rounded at the base than in *Chrysobalanus*; but it is also lined by a glandular disk, and on its edges are inserted the perianth and androceum. Certain species, such as *M. guianensis*[2] (figs. 489, 490), have a calyx similar to that of *Chrysobalanus*, and ten stamens, five superposed

Licania (Moquilea) guianensis.

FIG. 489.
Flower ($\frac{3}{1}$).

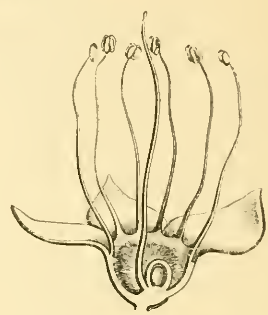

FIG. 490.
Longitudinal section of flower.

to the sepals, five alternate with them.[3] All are fertile, and consist of a long filament and an introrse two-celled anther. In other species[4] the number of stamens increases, and may become indefinite. We may rarely find ill-developed petals;[5] and still more rarely are there here only from eight to ten stamens.[6] But this number is more frequent in certain species which have been assigned to the genus *Caligui*.[7] Here too the stamens may be numerous,[8] but several

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TUSS., *Fl. Ant.*, iv. 91, t. 31.—DC., *loc. cit.*, n. 1.—BENTH., *Niger*, 336.—H. BN., *Adansonia*, vii. 221.—HOOK. F., *Mart. Fl. Bras.*, *Rosac.*, 7.—*C. ellipticus* SOL., ex. SAB., *Trans. Hort. Soc. Lond.*, v. 453.—*C. pellocarpus* MIQ., *Prim. Fl. Essequeb.*, 193.

[1] AUBL., *Guian.*, i. 521.—J., *Gen.*, 341.—LAMK., *Dict.*, iv. 272, *Ill.*, t. 735.—DC., *Prodr.*, ii. 526.—ENDL., *Gen.*, n. 6410 (part.).—B. H., *Gen.*, 606, n. 3.—*Batheogyne* and *Leptobalanus* (sect. *Licania*) BENTH., *Hook. Journ.*, ii. 212.

[2] AUBL., *loc. cit.*, t. 208.

[3] Some exceptionally tetramerous flowers have an androceum of only eight stamens.

[4] Especially in those forming the section *Eumoquilea* (HOOK. F., *Mart. Fl. Bras.*, *Rosac.*, 21).

[5] In this same section *Eumoquilea*.

[6] Even with a pentamerous calyx.

[7] *Licania* AUBL., *Guian.*, i. 119, t. 45.—J., *Gen.*, 340.—LAMK., *Dict.*, i. 561; Suppl., ii. 31; *Ill.*, t. 122.—DC., *Prodr.*, ii. 527.—SPACH, *Suit. à Buffon*, i. 374.—ENDL., *Gen.*, n. 6409.—B. H., *Gen.*, 606, n. 2.—*Hedycrea* SCHREB., *Gen.*, 160.

[8] There may be as many as fifteen in certain species of the section *Hymenopus* (BENTH.).

remain sterile, which we have seen occur in *Chrysobalanus*; and these staminodes are usually placed all on one side of the petal, which is, as we shall see, the case in *Hirtella, Parinari, Acioa*, &c. Some *Licanias* indeed, have only three fertile stamens.[1] All have short filaments compared with those of *Moquilea*. But as these characters drawn from the total number of stamens, the number of fertile stamens, and the length of the staminal filaments,[2] compared with that of the perianth-leaves, are all features which, in most genera, vary from group to group, without leading to their subdivision, except into subgenera or sections, so we shall leave in one and the same genus *Moquilea* and *Licania*, keeping for the whole the latter name, which has priority to recommend it. Thus constituted, this genus will be composed of half a hundred species, all natives of tropical America, from the Antilles to the south of Brazil;[3] trees or shrubs with alternate persistent simple leaves, often thick and covered with down on the under surface, the petiole accompanied by two lateral stipules below, and often with two lateral glands towards its junction with the blade. The small flowers are in simple or ramified racemes or spikes in the axils of little alternate bracts, where they are either solitary or in cymes or small glomeruli. The fruit is very variable in form in this genus, as in several others of this group. It is sometimes globular or ovoidal, sometimes elongated, and pear-shaped or club-shaped, obtuse or very acute at the apex. In consistency it is equally variable; it may be a drupe with abundant flesh, or a sort of nut or achene, with woody or crustaceous walls. The inside of the pericarp is sometimes lined with hairs. In the membranous seed-coats is a thick fleshy embryo.

The flowers of *Lecostemon*[4] are constructed on the same general type as those of the last two genera, and are hermaphrodite and polygamous; but they are distinguished at first sight by one striking character, though not in itself of any great importance; the stamens consist of a small slender filament, and a very long erect

[1] Such species as *Licania triandra, micrantha*, &c., which belong to the section *Eulicania* (Hook. F.).

[2] There are also species, such as, for example, *Licania polita* (*Fl. Bras.*, t. 4, ii.) which are, as regards the length of the filaments, intermediate between most species of *Licania* and *Moquilea* proper.

[3] Mart. & Zucc., *Nov. Gen. et Spec.*, ii. t. 166.—Zucc., *Nov. Stirp. Fasc.*, i. 387, 391.—Griseb., *Fl. Brit. W. Ind.*, 230.—Seem., *Her.*, 118, t. 25.—Hook. F., *Mart. Fl. Bras.*, *Rosac.*, 8, 20. t. 1–8.—Walp., *Rep.*, ii. 5; *Ann.*, i. 270; ii. 462; iv. 643.

[4] Moc. & Sesse, *Fl. Mex.*, *ined.*, ex DC., *Prodr.*, ii. 639.—Endl., *Gen.*, n. 6415.—Benth., *Hook. Journ.*, v. 293.—Hook. F., *Mart. Fl. Bras.*, *Rosac.*, 53.—B. H., *Gen.*, 609, n. 11.—Walp., *Ann.*, iv. 646.

basifixed caducous anther, with two lateral or slightly introrse cells dehiscing longitudinally. These stamens are very numerous, arranged in close-set whorls. They are inserted, just as in *Chrysobalanus* and *Licania*, on the inner edge of a receptacular cup, which also bears the calyx and corolla. The former is short, with its edges divided into five teeth or ill-marked crenelures, or else irregularly sinuous or nearly entire. The latter consists of five long exserted petals, imbricated in the bud. The receptacle is lined by a glandular disk. In the bottom is inserted the gynæceum (fig. 491), consisting of a one-celled ovary and a gynobasic style, which tapers at the tip and is grooved longitudinally along the whole of its inner edge. The two reflexed lips of this groove are covered with stigmatic papillæ. Close to the base of the ovary is seen a placenta bearing two obliquely ascending or sub-horizontal ovules. The fruit is a drupe, with a rather thin mesocarp; within its crustaceous stone is a seed, containing in its membranous coats a fleshy embryo, with conferruminate cotyledons and an incurved radicle. The genus *Lecostemon* consists of half a dozen shrubs from Mexico, Guiana, and Brazil, with alternate entire coriaceous petiolate leaves, whose two stipules are sometimes scarcely visible; the flowers are grouped in racemes with simple or cymose ramifications; the pedicels often droop and become more or less thickened after anthesis.

Lecostemon Gardnerianum.

FIG. 491. Gynæceum opened ($\frac{10}{1}$).

With the same general floral organization as the preceding genera, *Stylobasium*[1] (fig. 492) is peculiar in the hypogynous insertion of its androceum. The perianth is regular, forming a broad cup with the rim flattened and divided into five lobes quincuncially arranged in the bud. The flowers are polygamous, and it is only in some that the androceum is well developed. It is then represented by ten exserted stamens, each formed of a very slender filament

Stylobasium spathulatum.

FIG. 492. Longitudinal section of flower ($\frac{5}{1}$).

[1] DESF., *Mém. Mus.*, v. 37, t. 2.—DC., *Prodr.*, ii. 92.—ENDL., *Gen.*, n. 6417.—B. H., *Gen.*, 609, n. 12.—*Macrostigma*, HOOK., *Icon.*, t. 412.

inserted below the ovary, and a long basifixed introrse two-celled anther dehiscing longitudinally. In the purely female flowers the anthers are short and included.[1] The gynæceum is inserted in the very bottom of the flower just as in *Lecostemon*, and consists of a sessile one-celled ovary, and a gynobasic style dilated into a broad stigmatiferous plate. On a subbasilar placenta are borne two collateral ascending anatropous ovules, with their micropyles downwards and looking towards the style. The fruit is a drupe, with a thin mesocarp and a thin stone containing a seed, whose embryo is accompanied by only a little albumen. The radicle is inferior, and the thick cotyledons are transversely induplicate. Three species of *Stylobasium* are known;[2] bushy Australian shrubs, whose alternate simple leaves have stipules, which may be more or less rudimentary or even absent. The flowers are solitary, or in few-flowered cymes in the axils of the leaves.

b. *Gynæceum excentric.*

The plant from the Mascarene Islands, to which Commerson gave the name of *Grangeria*,[3] affords a transition between the genera we

Grangeria borbonica.

Fig. 493.
Flower ($\frac{12}{1}$).

Fig. 494.
Longitudinal section of flower.

have just studied and those *Chrysobalaneæ* which, as we shall see,

[1] They are in this case sterile.

[2] Nees, in *Lehm. Plant. Preiss.*, i. 95.—Benth., *Fl. Austral.*, ii. 427.

[3] Commers., ex J., *Gen.*, 340.—Lamk., *Dict.*, iii. 21; *Ill.*, t. 427.—DC., *Prodr.*, ii. 527.—Endl., *Gen.*, n. 6413.—B. H., *Gen.*, 607, n. 4.

possess a large receptacular tube, with the gynæceum inserted on one of its sides at a variable distance from its mouth. In *Chrysobalanus* and *Licania*, the insertion of the ovary is evidently as in the *Pruneæ*, in the centre of the receptacle. In *G. borbonica* (figs. 493, 494) this point is already slightly excentric. The floral organization is in other respects very near that which we have already observed in the *Licanias* of the section *Moquilea*. The calyx and corolla each possess five imbricated leaves. The receptacle, lined by a thin layer of glandular tissue, still bears on its edges about fifteen stamens arranged as in *Chrysobalanus oblongifolius*; each consists of a filament at first inflexed and then much exserted, and an introrse two-celled anther dehiscing longitudinally. The filaments are only united just at the base into a short collar like that of *Chrysobalanus*. The ovary covered over with long hairs contains two collateral erect ovules, whose micropyles look downwards and towards the insertion of the gynobasic style. This last is slender, rolled up in the bud and then long and much exserted; its stigmatiferous apex is not dilated. The flower is a drupe with a thin mesocarp and a trigonous one-seeded stone. Within the membranous seed-coats is a fleshy exalbuminous embryo with its radicle inferior.

In *G. porosa*,[1] another species of the same genus from Madagascar, the floral receptacle is more concave; the insertion of the ovary, corresponding with the edge of the receptacle, is hence higher up, and there are ten stamens, not all of which are fertile. Two or three, inserted in the opposite edge of the receptacle to that which bears the receptacular cup, remain as sterile tongues. The flower contains one or two seeds with very fleshy embryos.

Thus, of the two species included in this genus, the one has fertile stamens all round the receptacle, and the other only on one side; we shall see that the same alternative occurs in *Couepia* and *Parinari*. The genus *Grangeria* consists of glabrous or bristly shrubs, whose simple leaves possess two lateral caducous stipules. The flowers are in simple axillary or compound terminal racemes; each flower is borne on a slender pedicel axillary to a caducous bract.

In *Hirtella*[2] (figs. 495–500), too, we find the same one-sided inser-

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[1] H. Bn., *Adansonia*, viii. 161, 200, n. 1.

[2] L., *Gen.*, n. 80.—J., *Gen.*, 340.—Gærtn., *Fruct.*, iii. 40, t. 158.—Lamk., *Dict.*, iii. 133, Suppl., iii. 53; *Ill.*, t. 138.—DC., *Prodr.*, ii

tion of the gynæceum a little below the mouth of the receptacle. But here the development of the receptacular pit is exaggerated on one side, so as to form one of those deep depressions whose

Hirtella triandra.

Fig. 495.
Flower-bud.

Fig. 496.
Flower ($\frac{5}{1}$).

Fig. 497.
Flower, corolla removed.

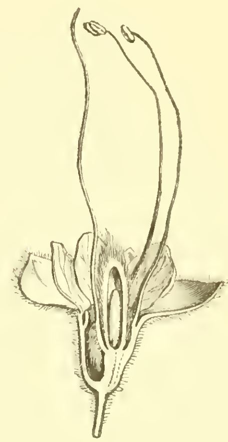

Fig. 498.
Longitudinal section of flower.

appearance has been compared to what is called the "adnate spur" of certain flowers. On the edges of the receptacular cup are inserted a perianth like that of *Grangeria,* and an androceum with at most ten stamens in the known species and usually still fewer. Thus *H. triandra*[1] (figs. 495–499) has only five stamens, of which but three are fertile, namely, those inserted on the same side as the gynæceum. They each consist of a filament involute in the bud and free for nearly its whole length, and an introrse two-celled anther dehiscing longitudinally.[2] At the base the stamens are connected by a little thickened ring, so that they are really monadelphous; on the side where the almost entire abortion of the andro-

Hirtella triandra.

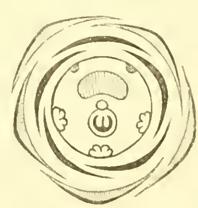

Fig. 499.
Diagram.

528.—Spach, *Suit. à Buffon,* i. 375.—Endl., *Gen.,* n. 6408.—B. H., *Gen.,* 608, n. 8.—*Cosmibuena* R. & Pav., *Prodr. Fl. Per.,* 10, t. 2 (nec *Fl.*).—*Causea* Scop., *Introd.,* n. 928.—*Brya* Velloz., *Fl. Flum.,* iv. t. 1.

[1] Sw., *Prodr.,* 57 : *Fl. Ind. Occ.,* i. 508.—*H. americana* Jacq., *Amer.,* 8, t. 8.—*H. punctulata* Miq., in *Linnæa,* xix. 439.

[2] The pollen, according to H. Mohl. (*Ann. Sc. Nat.,* sér. 2, iii. 341), is analogous to that of *Chrysobalanus;* but the three or four bands on each grain are destitute of papillæ.

ceum takes place, we only see two little teeth projecting from the edge of this ring; like the fertile stamens each is superposed to a sepal. The gynæceum consists of a single carpel superposed to a sepal;[1] it is made up of a one-celled ovary, and a slender gynobasic style inserted at the foot of the ovary on the side next to the unilateral pit of the receptacle, and terminated by a very small stigmatiferous head. Near the base of the ovary is seen a placenta from which arise two collateral anatropous ovules whose micropyles look downwards and towards the insertion of the style. The fruit is a drupe, whose stone contains a single seed with an exalbuminous embryo, thick fleshy cotyledons, and an inferior radicle.

Hirtella hirsuta.

FIG. 500.
Flower (4/1).

The flowers of the other species of *Hirtella* are similarly formed, but possess a larger number of fertile stamens. Thus *H. hirsuta* (fig. 500) has six, possessing a pair in the place of each single one of *H. triandra;* so too with *H. brachystachya, elongata, americana,*[2] &c.; also with *H. Thouarsiana,*[3] a species from Madagascar which had been made into a distinct genus under the name of *Thelira.*[4] When instead of one or two stamens there are three before one or more of the sepals, the androceum consists of seven, eight, or nine pieces. The fruit of *Hirtella* is a more or less elongated drupe, whose mesocarp is of very variable thickness and consistency and whose stone contains a single seed, within whose membranous coats is the fleshy

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[1] Sepal 3, as in *Chrysobalanus* (fig. 499).

[2] AUBL., *Guian.*, i. 247, t. 98 (nec JACQ.).—*H. hexandra* W., ex RŒM. & SCH., *Syst.*, v. 274.—*H. nitida* W., *loc. cit.*—*H. racemosa* LAMK., *Dict.*, iii. 133.—*H. oblongifolia* DC., *loc. cit.*, n. 10.—*H. filiformis* PRESL., *Symb.*, ii. 23, t. 68.—*H. coriacea* MART. & ZUCC., in *Abh. Münch. Akad.*, x. 383. This species may have seven or eight stamens, when there are three instead of two before one or two of its sepals; so again, when one or two of these pairs are replaced by single stamens, the androceum is reduced to four or five pieces; all facts affording a good explanation of the symmetry of the stamens in this species, and some others of the same group.

[3] H. BN., *Adansonia*, viii. 160.

[4] DUP.-TH., *Gen. Nov. Madag.*, n. 72.—DC., *Prodr.*, ii. 527.—ENDL., *Gen.*, n. 6412.—B. H., *Gen.*, 607 (*Parinarium*).—H. BN., *loc. cit.*, 159.

exalbuminous embryo. Its radicle is inferior, and its cotyledons touch by a flat or more or less sinuous surface; they are even said to be folded one within the other in *Thelira.* Of about two score species now admitted in this genus, this is the only native of the Old World; the rest are all trees or shrubs from tropical America,[1] especially common in Brazil and Guiana, and much rarer in the Antilles; their leaves are alternate simple and petiolate, with two caducous lateral stipules; the flowers are in axillary or terminal racemes, either simple or branching, or composed of cymes which are often uniparous above a certain level. These flowers are axillary to bracts, usually covered with hairs, which may be glandular and may also be found even on the edges of the calycine leaves, especially in the Madagascar species.

Couepia[2] may be described as *Hirtella* in which the androceum consists of at least fifteen stamens and often of more. Sometimes these fertile stamens are all on one side of the flower as in *Hirtella*, and then the narrow ring formed by the union of the bases of the staminal filaments has only a variable number of little teeth or staminodes on the other side. Sometimes on the contrary there are a large number of fertile stamens all round the flowers; they are arranged as in the *Rosaceæ* generally, and may be intermixed with more or less elongated sterile filaments. The elongated tubular receptacle with its glandular lining, the perianth, and the gynæceum are altogether those of *Hirtella.* The ovary sometimes presents a rudimentary false dissepiment between its two collateral ovules.[3] The fruit is drupaceous, its mesocarp is of very variable form and thickness.[4] *Couepia* consists of two-score species of trees and shrubs from tropical America;[5] the leaves are alternate simple and petiolate,[6] accompanied by two caducous lateral stipules. The flowers

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[1] R. & PAV., *Fl.*, t. 227.—MIQ., *Stirp. Surin.*, t. 7.—GRISEB., *Fl. Brit. W.-Ind.*, 229.—CHAM. & SCHLTL., *Linnæa*, ii. 548.—BENTH., *Hook. Journ.*, ii. 216.—MART. & ZUCC., *loc. cit.*, 373.—SEEM., *Her.*, 118.—HOOK. F., *Mart. Fl. Bras.*, *Rosac.*, 27, t. 9–12.—WALP., *Rep.*, ii. 1; v. 646; *Ann.*, i. 270; ii. 462.

[2] AUBL., *Guian.*, 519, t. 207.—DC., *Prodr.*, ii. 526.—BENTH., *Hook. Journ.*, ii. 212.—B. H., *Gen.*, 608, n. 9 (part. et excl. syn.).—*Acia* W., *Spec.*, iii. 717.—*Dulacia* NECK., *Elem.*, n. 1236?—*Moquilea* (part.). BENTH., *loc. cit.* (nec AUBL.).

[3] Which greatly diminishes the value of *Parinari* as a separate genus.

[4] As in *Licania* and *Hirtella.* The pericarp is dry or drupaceous, globular, ovoidal, or obovate, or curved and reniform.

[5] MART. & ZUCC., *Nov. Gen. et Spec.*, ii. 80, t. 166; in *Flora* (1832), Beibl. ii. 90; in *Abh. Münch. Akad.*, x. 388.—PŒPP. & ENDL., *Nov. Gen. et Spec.*, i. 75.—HOOK. F., *Mart. Fl. Bras.*, *Rosac.*, 41, t. 13–16.—WALP., *Rep.*, ii. 6.

[6] There are sometimes two lateral glands at the top of the petiole.

are in axillary or terminal racemes, simple, ramified or made up of cymes.

Parinari[1] (fig. 501) may be very briefly defined now that we know the preceding genera: it is *Couepia* in which the stamens, from ten to twenty in number or indefinite, are fertile either only on one side of the flower or all round the receptacle, while the ovary is divided into two uniovulate half-cells by a vertical false dissepiment, which advances from its walls into the interval between the two collateral ovules. We often find this represented in the drupaceous fruit,[2] for the stone may be divided into two one-seeded cavities. *Parinari* consists of trees of which upwards of thirty species have been described; they have alternate persistent simple leaves, the blade often provided with two lateral glands at its base, the petiole with two lateral stipules. The flowers are in racemes or corymbs, either simple or made up of cymes.[3] About half the species inhabit tropical America,[4] the rest belong to the Old World, to tropical and eastern Africa,[5] to Australia,[6] and some, finally, to the Indian Archipelago.[7] Among these last there are species whose flowers often have a reduced number of stamens, and a shallower receptacle than in *Hirtella* or *Couepia*. They have, however, been united to the genus *Parinari* despite these points of dissimilarity, because their ovary and flower present the false dissepiment between the ovules or seeds;

Parinari senegalensis.

FIG. 501.
Perianth and androecium opened out.

[1] AUBL., *Guian.*, i. 514, t. 204, 206.—*Parinarium* J., *Gen.*, 342.—LAMK., *Dict.*, v. 17; Suppl., iv. 301; *Ill.*, t. 429.—DC., *Prodr.*, ii. 526.—SPACH, *Suit. à Buffon*, i. 371.—ENDL., *Gen.*, n. 6411.—B. H., *Gen.*, 607, n. 5.—*Petrocarya* SCHREB., *Gen.*, 245.—*Balantium* DESVX., *Ham. Prodr. Fl. Ind. Occ.*, 34.—*Dugortia* SCOP., *Introd.*, n. 956.—*Maranthes* BL., *Bijdr.*, 89.—*Exitelia* BL., *Fl. Jav. Praef.*, vii.—*Grymania* PRESL., *Epimel.*, 193.—*Lepidocarya* KORTH., *Ned. Kruidk. Arch.*, iii. 386.—*Entosiphon* BEDD., *Madr. Journ. Sc.*, ser. 3, i. 44 (ex B. H.).

[2] Exceptionally we may find certain dicarpellary flowers produce two drupes.

[3] The inflorescence is branched in the species of which DE CANDOLLE has made his section *Petrocarya*, while his *Neocarya* is described as possessing simple terminal racemes. In short, the inflorescence of *Parinari* presents every variation observed in *Couepia*.

[4] BENTH., *Hook. Journ.*, ii. 213.—MART., *Obs.* (1819), n. 2670.—HOOK. F., *Mart. Fl. Bras., Rosac.*, 49, t. 17, 18.

[5] SAB., *Trans. Hort. Soc.*, v. 451.—PERR. & GUILL., *Fl. Seneg. Tent.*, i. 272, t. 61, 62. *P. senegalense* PERR., described in this work, from which our fig. 501 is taken, is the *Neou* of ADANSON (ex J., *Gen.*, 342). The second species there mentioned, *P. excelsum* SAB., is the *Mampata* of ADANSON (ex J., *loc. cit.*)—BENTH., *Niger*, 333.—HARV. & SOND., *Fl. Cap.*, ii. 596.—H. BN., *Adansonia*, vii. 221; ix. 148.

[6] BENTH., *Fl. Austral.*, ii. 426.

[7] MIQ., *Ann. Mus. Lugd. Bat.*, iii. 237; *Fl. Ind.-Bat.*, i. p. 1, 352; Suppl., i. 306.—A. GRAY, *Bot. Unit. States Expl. Exp.*, t. 54, 55.—KORTH., *Verh. Nat. Gesch.*, 259, t. 70.—For the species of various countries see WALP., *Rep.*, ii. 7; v. 647; *Ann.*, ii. 463; iv. 644.

but the existence of a rudiment of this internal process of the ovarian wall in *Couepia* proves the close relationship of that genus to *Parinari* and the little value of the latter one.[1]

In the Coupis[2] (figs. 502, 503) we find the receptacle of *Hirtella Couepia* and most species of *Parinari*, with its deep unilateral tube. In the flowers of *Acioa guianensis*, the prototype of this genus, we find five imbricated sepals, and as many alternating imbricated petals. There are from ten to fifteen fertile stamens all on one side of the flower; on the other, that of the receptacular tube, the androceal ring only bears a variable number of little sterile teeth. But the filaments of the fertile stamens are united together for a long way up into a long strap-like band, spirally involute in the bud, and then spreading a long way on one side of the expanded flower. Towards the apex the filaments become free and support each a short introrse two-celled anther dehiscing longitudinally. The gynæceum is inserted and formed as in *Hirtella*. Its very long basilar style ends in a scarcely dilated stigma; it is rolled up in the bud and exserted on anthesis. The fruit is a drupe with a usually dry hard thick mesocarp and a one seeded endocarp; the radicle of the embryo is inferior.

Acioa guianensis.

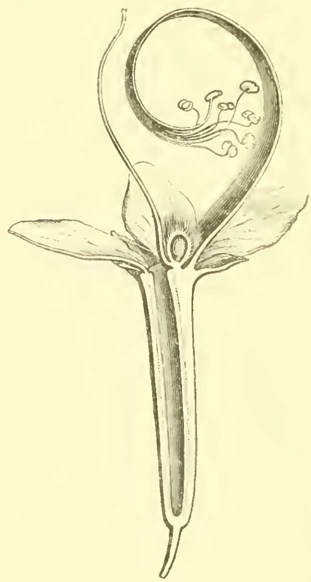

FIG. 502.
Longitudinal section of flower ($\frac{3}{1}$).

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[1] We have been unable to study the genus *Trichocarya* (MIQ., *Fl. Ind.-Bat.*, i. 357; Suppl., i. 116), which BENTHAM & HOOKER place (*Gen.*, 607, n. 6) beside the genus *Parinari*, and which, with the characters of the last species, a pentamerous flower, an androceum of about twenty-five stamens inserted all round the flower, is said to present a tubular, cylindrical receptacle, entirely filled up by an accrescent gynophore. The ovary, inserted on top of the receptacular tube, is described as containing one (?) ovule, and as accompanied by a basilar style. The fruit is a drupe, with a coriaceous endocarp lined with hairs. Two species of this genus have been described, one from Borneo, the other from Sumatra, named by KORTHALS (*Ned. Kruidk. Arch.*, iii. 384, 388) *Angelesia splendens* and *Diemenia racemosa* respectively. Were it not for the singular character of the gynophore, which, according to MIQUEL himself, needs verification, it would seem that these plants should be referred to the genus *Parinari*. In his last work on these plants MIQUEL (*Ann. Mus. Lugd.-Bat.*, iii. 236) has maintained as distinct genera *Angelesia* and *Diemenia*, which, as we have just seen, had been united by BENTHAM & HOOKER in 1865. It appears that the herbarium at Leyden does not contain enough specimens to allow any clear and definitive judgment to be given on these points.

[2] *Acioa* AUBL., *Guian.*, 698, t. 280.—DC., *Prodr.*, ii. 526.—SPACH, *Suit. à Buffon*, i. 371. —H. BN., *Adansonia*, vi. 222.—*Acia* (part.) W., *loc. cit.*—*Dulacia* NECK., *Elem.*, n. 1236 (ex DC.).—*Couepia* (part.) B. H., *Gen.*, 608, n. 9.

The name *Griffonia*[1] has been given to certain African plants whose flower is constructed like that of *A. guianensis*, and which cannot be generically separated from it. The fillet formed by the fertile stamens may here be even longer than in the Guiana species, and of these fertile stamens there are from ten to fifteen and upwards, always unilateral. The fruit is of very variable form.[2] Already we know of five or six species from the west of tropical Africa.[3] Thus constituted, the genus *Acioa* consists of erect or climbing trees or shrubs, with simple entire alternate leaves, with two caducous lateral petiolary stipules. The flowers are axillary or terminal, collected into racemes simple, branched, or composed of cymes. The bracts are pretty often glandular, like those of *Hirtella*, and the same may be the case with the sepals.

Acioa guianensis.

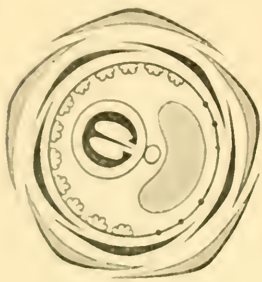

FIG. 503. Diagram.

Parastemon[4] has flowers analogous to those of the Asiatic species of *Parinari* which we described last. The receptacle is shallow and cupuliform, and on one side of it is inserted a gynæceum, which may or may not be fertile, for the flowers are polygamo-diœcious. On its edges are borne a calyx of five imbricated sepals, a corolla of five caducous petals, also imbricated, and an androceum which consists of only two fertile stamens superposed to two sepals. Each of these stamens is composed of a filament longer than the corolla, involute in the bud, and a versatile introrse two-celled anther. The receptacle is lined by a glandular disk, whose rim is especially thickened at the side opposite the insertion of the stamens. The ovary possesses a slender basilar style; it becomes a glabrous oblong fruit, obtuse at the apex, with a nearly woody pericarp containing a single seed, whose thin membranous coats envelope an erect exalbuminous embryo. The only known species of this genus is *P. urophyllus*,[5]

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[1] HOOK. F., *loc. cit.*, n. 10 (nec H. BN.).

[2] "*Nux sicca, oblonga vel obpyriformis, subcompressa, crustacea*, 1-*sperma, loculo intus pilis fulvidis hispido*" (B. H., *loc. cit.*). As in *Couepia*, &c., the carpel is superposed to sepal 3. Moreover, we have shown that there is no character sufficiently distinctive to mark off the *Coupi* of Guiana generically from the species of tropical Africa, of which we make a simple section in this genus under the name of *Lorandra* (HOOK. F., *mss.*).

[3] H. BN., *loc. cit.*, 223, 224, note.

[4] A. DC., *Ann. Sc. Nat.*, sér. 2, xviii. 208.—PL., *Ann. Sc. Nat.*, sér. 4, ii. 258.—B. H., *Gen.*, 607, n. 7.

[5] A. DC., *loc. cit.*—WALP., *Ann.*, iv. 648.—*Embelia urophylla* WALL., *Cat.*, 2309.—A. DC., *Trans. Linn. Soc.*, xvii. 131

a glabrous shrub from Malaysia, whose alternate simple persistent lanceolate leaves possess ill-developed lateral stipules. The flowers are small and numerous, in lax slender axillary or terminal racemes.

The group of the *Rosaceæ* is so very natural that its extent and limits were early foreseen. B. DE JUSSIEU, in his Catalogue of the Garden of the Trianon,[1] and ADANSON, in his "*Familles des Plantes*,"[2] may, however, be considered as having clearly marked out, the one a Natural Order (*Rosaceæ*), the other a Family of the Roses (*Rosæ*). A. L. DE JUSSIEU, in defining his order *Rosaceæ*,[3] greatly enlarged the frame drawn up by his predecessors; for, besides the genera of *Rosaceæ* now-a-days admitted by botanists, he included *Tetracera*, *Tigarea*, and *Delima*, which are *Dilleniaceæ; Suriana*, now placed in *Rutaceæ; Prockia*, a genus since attributed to *Bixaceæ* or *Tiliaceæ;* those *Homaliaceæ* that were known in his time, viz., *Homalium*, *Napimoga* and *Blackwellia*, besides *Calycanthus* and *Plinia*, a Myrtad. It was A. P. DE CANDOLLE[4] who definitively excluded most of these genera from *Rosaceæ;* and, with the exception of *Cephalotus*[5] *Amoreuxia*[6] and *Trilepisium*,[7] the genera which he kept in this order are still maintained by most botanists of the day. He also resisted the tendency to follow the example, which R. BROWN[8] had recently set in considering as so many distinct orders the secondary tribes which A. L. DE JUSSIEU had made in his single order *Rosaceæ*, viz., *Pomaceæ*, *Rosæ*, *Sanguisorbæ*, *Potentillæ*, *Spireæ*,[9] *Amygdaleæ*. But ENDLICHER[10] and LINDLEY[11] followed this example. The former distinguished in his large class *Rosifloræ*, the five orders *Pomaceæ*, *Calycantheæ*, *Rosaceæ* (subdivided into *Rosæ*, *Dryadeæ*, *Spiræaceæ*, and *Neuradeæ*[12]) *Amygdaleæ* and *Chrysobalaneæ*; the latter made the

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[1] 1759, ex A. L. J., *Gen.*, lxx.

[2] II. (1763), 14, 286, Fam. xli.

[3] *Op. cit.*, 334, Ord. x.

[4] *Prodr.*, ii. (1825), 525–639.

[5] Which belongs to *Saxifragaceæ* or *Crassulaceæ*.

[6] Placed among *Bixaceæ* by BENTHAM & HOOKER (*Gen.*, 124).

[7] DUP.-TH., *Gen. Nov. Madag.*, 22, n. 74.—DC., *Prodr.*, ii. 639.—ENDL., *Gen.*, n. 6416. "*E charactere dato certe non hujus ordinis.*" (B. H., *Gen.*, 605.)

[8] See *Congo* (1818), 433; *Misc. Works*, ed. BENN., i. 115.

[9] We here suppress that of the *Prockieæ* (339), which besides *Prockia*, only includes Dilleniads, with the exception of *Hirtella*, which was the only genus of *Rosaceæ* in the tribe. It belongs, as we have seen, to *Chrysobalaneæ*.

[10] *Gen.* (1836–1840), 1236, Cl. lxi.

[11] *Veg. Kingd.* (1846), 539, All. xlii.

[12] This little group, made up of the genera *Neurada* and *Grielum*, since the time of A. L. DE JUSSIEU, has been referred to *Rosaceæ*, which

five groups *Chrysobalanaceæ*,[1] *Drupaceæ*,[2] *Pomaceæ*,[3] *Sanguisorbaceæ*[4] and *Rosaceæ* proper, distinct orders of his alliance *Rosales*, in the same category with *Leguminosæ* (*Fabaceæ*) and *Calycanthaceæ*.

In the *Rosaceæ*, as understood by A. P. DE CANDOLLE, were sixty-nine genera admitted before his time or by him, which are, in our enumeration, reduced to sixty-five. Of these sixteen were Linnean genera, namely, *Rosa*, *Agrimonia*, *Alchemilla*, *Sanguisorba*, *Cliffortia*, *Fragaria*, *Potentilla*, *Rubus*, *Geum*, *Dryas*, *Spiræa*, *Pyrus*, *Cratægus*, *Prunus*, *Chrysobalanus*, and *Hirtella*. He retained *Cydonia* of TOURNEFORT;[5] AUBLET'S[6] four genera, *Couepia*, *Acioa*, *Parinari*, and *Licania*; *Polylepis*, *Margyricarpus*, *Kageneckia*, and *Smegmadermos*[7] of RUIZ & PAVON; *Grangeria* of COMMERSON,[8] *Acæna* of VAHL,[9] *Lindleya*, *Cercocarpus* and *Brayera* of KUNTH,[10] *Gillenia* of MŒNCH,[11] and *Neillia* of DON.[12] DE CANDOLLE had himself established[13] the two new genera *Purshia* and *Kerria*, and adopted those which LINDLEY had just proposed[14] in his group *Pomaceæ*, namely, *Raphiolepis*, *Chamæmeles*, *Eriobotrya*, *Osteomeles* and *Amelanchier*.[15] *Stylobasium*, established by DESFONTAINES in 1819, was still referred to *Terebinthaceæ*. The genus *Eucryphia* of CAVANILLES[16] was placed with *Hypericineæ* or *Chlenaceæ*; nor was *Pygeum* of GÆRTNER[17] yet considered one of *Rosaceæ*; while *Lecostemon* of MOCINNO & SESSE[18] was only considered a doubtful member of the order. In fine, the number of the genera then known, now admitted by us in this order, reached forty-three.

The other twenty-one genera are of contemporary or nearly contemporary origin. The greatest number are due to the English

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it closely approaches, it is true, in the situation of its carpels; but it appears to us to approach the *Biebersteinieæ* more closely than any other natural group; so that we shall have nothing more to say about it in the enumeration of the different genera of the Order *Rosaceæ*.

[1] LINDL., *Introd.*, ed. 2, 158; *Veg. Kingd.*, 542, Ord. ccviii.—*Chrysobalaneæ* R. BR., *loc. cit.*—DC., *Prodr.*, ii. 525.—ENDL., *Gen.*, 1251, Ord. cclxxiv.

[2] DC., *Fl. Fr.*, iv. (1805), 179.—LINDL., *op. cit.*, 557, Ord. ccx.—*Amygdaleæ* JUSS., *Gen.*, 340.—ENDL., *Gen.*, 1250, Ord. cclxxiii.

[3] LINDL., *Trans. Linn. Soc.*, xiii. (1821), 93—ENDL., *Gen.*, 1236, Ord. cclxx.

[4] *Veg. Kingd.*, 561, Ord. ccxii.—*Cliffortiaceæ* MART., *Consp.*, 216.

[5] *Inst.*, i. (1700), 632.

[6] *Pl. de la Guyane Franç.* (1775).

[7] Described earlier by MOLINA (1782), under the name of *Quillaja*, and placed by A. L. DE JUSSIEU (*Gen.* 441) among the *Gen. incertæ sedis*.

[8] Ex J., *Gen.* (1789), 340.

[9] *Enum.*, i. (1804–1806), 273.

[10] *Nov. Gen. et Spec. Pl. Æquin.*, vi. (1823), and in BRAYER, *Note sur une Nouv. Pl. Rosac.* (1823).

[11] *Meth.*, Suppl. (1802), 286.

[12] *Prodr. Fl. Nepal.* (1802, 1803), 228.

[13] *Trans. Linn. Soc.*, xii. p. ii. (1818), 152–159.

[14] *Trans. Linn. Soc.*, xiii. (1821), 93.

[15] Reproduced from MEDICUS, *Gesch. d. Botan.* (1793).

[16] *Icones*, iv. (1797), 49, t. 372.

[17] *De Fruct. et Semin. Plant.*, i. (1788), 218.

[18] Ex DC., *Prodr.*, ii. (1825), 639.

and American botanists, who, from 1822 to 1867, established the thirteen genera *Nuttallia, Exochorda, Prinsepia, Adenostoma, Cowania, Bencomia, Stranvæsia, Maddenia, Canotia, Coleogyne, Chamæbatia, Neviusia* and *Strephonema.* During nearly the same period the Germans established the genera *Euphronia*,[1] *Pterostemon*,[2] *Fallugia*[3] and *Leucosidea*.[4] SIEBOLD & ZUCCARINI, in their investigations of the flora of Japan, discovered the two genera *Stephanandra*[5] and *Rhodotypos*.[6] A. DE CANDOLLE described the genus *Parastemon* in 1842, and MIQUEL has recently given a more detailed account[7] than KORTHALS of *Diemenia* and *Angelesia,* united by others under the generic name of *Trichocarya*.[8]

It will be asked, does the order *Rosaceæ,* of which the genera here retained include from nine hundred to a thousand species, possess any common absolute characters? We think not. The flowers, for instance, are no doubt very often regular; but this is not constant, for a large number of *Chrysobalaneæ* have a unilateral androceum, an excentrically inserted gynæceum, a receptacle with a one-sided tubular cavity. Again, the receptacle is very often concave, with the perianth and androceum perigynous; so that, generally speaking, we may consider *Rosaceæ* a perigynous *Ranunculaceæ.* But the stamens are hypogynous not only in *Canotia,* which is a genus of doubtful affinities, but also in *Stylobasium,* which cannot be removed to any distance from *Lecostemon.* The gynæceum is often polycarpous; but the ovary is syncarpous and many-celled in a fair number of the *Quillajeæ,* such as *Exochorda, Lindleya, Euphronia, Eucryphia,* &c. Albumen is usually wanting in the seeds; but it is found to a variable amount in *Neillia, Gillenia, Neviusia, Eucryphia, Euphronia, Canotia, Purshia, Chamæbatia, Cowania,* &c. The leaves are almost always alternate; yet they become opposite in *Rhodotypos,* which presents in all other respects the vege-

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1 MART., *Nov. Gen. et Spec.*, i. (1824), 121.

2 SCHAUER, *Linnæa*, xx. (1847), 736.

3 ENDL., *Gen.* (1836–1840), 1246.

4 ECKL. & ZEYH., *Enum. Pl. Cap.* (1834–1837), 265.

5 *Abh. Münch. Akad.*, iii. (1843), 739.

6 *Fl. Jap.*, 187, t. 90 (1835).

7 *Ann. Mus. Lugd. Bat.*, iii. (1867), 236.

8 *Fl. Ind.-Bat.*, i. p. i. (1855), 357. As a doubtful genus of *Rosaceæ*, has been described *Staphylorhodos* (TURCZ., *Bull. Mosc.* (1862), ii. 231), a genus said to come from New Zealand, but wrongly, say BENTHAM & HOOKER (*Gen.* 606), who consider this type altogether uncertain.

tative organization of *Kerria*[1], in *Eucryphia* and in *Coleogyne*. We usually find stipules, but they are missing in several *Spireeæ*, in *Nuttallia* and *Exochorda*, and in several *Chrysobalaneæ*. But we may still say, speaking generally, and taking care to bear in mind their numerous exceptions, that the *Rosaceæ* may be considered perigynous *Ranunculaceæ*, with stipulate leaves and exalbuminous seeds.

The characters which, though valuable, are variable, have served to establish the tribes, of which we give briefly here the most important features in agreement with the most recent authors. These series are, as we have seen, eight in number.

I. Roseæ.—Ovaries inferior or included in the receptacular cavity. Fruits dry, included in a fleshy indusium of receptacular origin. Calycle absent. Ovaries uni- or bi-ovulate. Ovules descending, micropyle exterior. Leaves nearly always pinnate. Stem woody.

II. Agrimonieæ.—Fruits dry included in a dry or rarely fleshy indusium. Corolla usually absent. Calycle nearly always absent. Ovaries uniovulate. Ovules descending, micropyle exterior. Stem herbaceous or woody.

III. Fragarieæ.—Ovaries free, not included in the cavity of the receptacle. Fruits superior. Ovules solitary or geminate, ascending or descending, micropyle exterior. Stem herbaceous or frutescent.

IV. Spireeæ.—Carpels not included, solitary or numerous. Ovules solitary, geminate or numerous. Calycle often absent.

V. Quillajeæ.—Carpels not included, usually equal in number to the sepals, free, or united into a many-celled fruit. Ovules geminate or numerous, ascending or descending, micropyle exterior. Calycle absent. Stem woody.

VI. Pyreæ.—Carpels wholly or almost wholly lodged in the receptacular cavity, solitary or few in number, at most equal to the sepals. Fruit pomaceous, usually crowned by the remains of the calyx or its scars. Ovaries nearly always uniovulate. Ovules collateral ascending, micropyle exterior and inferior. Stem woody.

VII. Pruneæ.—Carpel nearly always solitary, free, not included. Style inserted in the summit of the ovary. Ovules geminate, collateral descending, micropyle superior and exterior. Stem woody. Leaves simple.

VIII. Chrysobalaneæ.—Flowers often unsymmetrical. Carpel

[1] In cultivation we may pretty often see the leaves become opposite in *Spiræa*, *Rubus*, *Rosa*, *Prunus*, &c.

nearly always solitary. Style gynobasic. Ovules geminate collateral, ascending, micropyle inferior, looking towards the insertion of style. Stem woody. Leaves simple.[1]

Affinities.—Many authors have pointed out the relations of the *Rosaceæ* to those *Polycarpicæ* near which we now place them. The *Calycantheæ* have even been placed in the order *Rosaceæ*, and we know how close are their affinities with *Magnoliaceæ*, especially with *Illicieæ*, from which they only differ in the form of the receptacle. Now as the receptacle is altogether that of the Roses, the only character separating *Calycantheæ* from *Rosaceæ*, is the arrangement of the pieces of the androceum, spiral in the former, verticillate in the latter. But this difficulty is really of the less fundamental importance, as in *Ranunculaceæ* we have seen genera with curviseriate, and others with verticillate stamens, united in one and the same order. This last order has been violently removed from *Rosaceæ* by an over-strict application of A. L. de Jussieu's principles as regards the value of the insertion, the direct consequence of the configuration of the receptacle. The *Rosaceæ* once relegated in *Perigynæ*, far from the hypogynous orders of which *Ranunculaceæ* are the commonest type, people naturally overlooked the striking identity of all the other parts which leads the vulgar instinctively to put white or yellow flowered Crowfoots (*Boutons-d'argent* or *d'or*) in the same category with Potentils, whose flowers are of the same colour. No doubt hypogyny gives a distinct general character to *Ranunculaceæ*, just as perigyny does to *Rosaceæ*; but we must bear in mind that the perigyny is nearly lost in *Stylobasium*, as in many of the *Fragarieæ*, while on the other side there are *Ranunculaceæ* with a slightly perigynous

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[1] It is impossible to make any general study of the anatomical structure of the *Rosaceæ*. Some of the trees of this order are of the number of those which have served to establish the generally admitted type of the ordinary structure of the stem in Dicotyledons. Such are especially the genera *Prunus* and *Pyrus* (Mirb., *Mém. Mus.*, xvi. (1828), 29, 30;—Link., *Icon. Sel.*, fasc., i. vi. 1–3; viii. 3–5;—H. Mohl., *Bot. Zeit.* (1855), 879;—Schacht. *Der Baum*, 195;—Wigand, *Uber die Organis. d. Pflanz.*, *Pringhs. Jahrb.*, iii. 115), *Rubus* (Kies., *Mém. sur l'Org. des Pl.* (1814), t. 16;—Schultz (C. H.), *Die Cycl.*, *Nov. Act.*, xviii. (1841), Suppl., ii. t. 25), *Rosa* (Meyen, *An. Und. Phys. d. Gew.* (1836), t. iii. 11).—See also Oliver, *The Struct. of the Stem in Dicol.*, 12. The *Chrysobalaneæ* have been little studied from a histological point of view (see H. Mohl., *Bot. Zeit.* (1861), 211, and Wicke, 97). It is uncertain whether the singular plant called *Canto* or *Canta*, from the Antilles, studied by Crueger (*Bot. Zeit.* (1857), 281, 298), remarkable for its parenchyma intersected by bands of a peculiar cellular tissue, and the deposits of cellular tissue in its stem, it is uncertain, we say, whether this is really a Chrysobalanad.

insertion, like the Pæonies; that *Crossosoma*, whether we make it belong to *Ranunculaceæ*, or its next-door neighbour *Dilleniaceæ*, has an unmistakeably concave receptacle, and that in this same order *Dilleniaceæ*, there is one *Hibbertia* with the receptacle of *Potentilla*, though it is quite inseparable from the other *Hibbertias*, and at one time placed among *Rosaceæ* under the name of *Warburtonia*.

There are two other orders, so closely allied with *Rosaceæ*, so little distinguished by any absolute character whatever, that their separation from it must be regarded as a matter of pure convention, these are *Saxifragaceæ* and *Leguminosæ*.

As regards the former we do not refer to the commonest type, represented by the Saxifrages themselves and the allied herbaceous genera; the knowledge of these types, more widely diffused than that of the peripheral genera of the natural order, has led most authors to leave *Saxifragaceæ* among the group of orders with parietal placentation, and there we too shall leave them; for in a linear series it is impossible to consider simultaneously all affinities and characters of importance. But apart from the fact that most natural orders whose flowers have gynæceums with several free carpels, may also include genera, which though otherwise quite similar, have their carpels united edge to edge into a single ovary with several parietal placentas:[1] we have in the tribe *Cunonieæ* genera whose carpels are free, or nearly free, and flowers altogether formed like those of several *Spireeæ*; the fruit, inflorescence and habit, are the same on both sides, so that it will thus be understood how certain genera have been placed under different names in *Saxifragaceæ* and *Rosaceæ* indifferently.[2] True, there is one way, regarded as entirely infallible till quite recently, to distinguish the two orders, when we can examine the structure of the seeds; those of the former order having been considered as invariably albuminous, of the latter invariably exalbuminous. But now unfortunately this is lost as a distinctive character, for we know many *Rosaceæ* whose embryo is surrounded by a more or less abundant layer of perisperm, as we have seen in the

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[1] Such as *Monodora* in *Anonaceæ*, *Berberidopsis* in *Berberidaceæ*, *Canelleæ* in *Magnoliaceæ*, &c. (See pp. 119, 159, 166, 239, 255).

[2] We need only recall the fact that *Neillia* has been classed among *Saxifragaceæ*, and *Astilbe* was for some time regarded as belonging to *Rosaceæ*, under the respective names of *Adenilema* and *Hoteia*. *Luetkea* or *Eriogyna*, which is really only a member of *Spireeæ* had also been considered a genus of the order *Saxifragaceæ*.

case of *Gillenia*, *Rhodotypos*, *Neillia*, *Canotia*, *Purshia*, &c.; and, on the other hand, in certain very natural secondary groups, like that embracing *Brexia* and *Roussæa*, which botanists are now-a-days agreed in including in the general group *Saxifragaceæ*, we find a perisperm abundant in the one genus, absent in the other.[1] In short, a Saxifrage has hardly any character in common with a Rose or Pear; the types which in these two divisions of the vegetable kingdom occupy the centre, the culminating point of the region, are essentially distinct; but towards the common boundary of the two districts there is at present no absolute line of demarcation.[2]

The same applies to the *Leguminosæ*; and it would seem childish to attempt any distinction between the two orders were they not represented the one, say, by the Apple, the other by the Pea or Kidney Bean. On the one hand regular polyandrous pluricarpellary flowers, what is termed an inferior fruit, and a plurilocular pericarp, fleshy to a great extent; on the other, free dry dehiscent unicarpellary fruits—pods in short, with a flower as irregular as possible, a papilionaceous corolla and a quite peculiar androceum; these, if any, are enormous differences in the vegetable kingdom. Yet the *Chrysobalaneæ* with a biovulate ovary inserted on one side of the receptacular cup, become so far similar to certain *Cæsalpinieæ* with a uni- or pauciovulate ovary of excentric insertion. For the elongated dry pod of the *Leguminosæ*, are substituted in certain *Dalbergieæ*, as also in some *Cæsalpinieæ*, short one-seeded indehiscent fruits, even drupes in certain genera, or true achenes just as in several *Rosaceæ*; the *Connaraceæ*, too, are as closely linked by their seeds and fruits to certain *Spireeæ*, whose flowers they also possess, as to the peculiar group of the *Detarieæ* and *Copaiferæ* which are inseparable from *Leguminosæ*. And those members of *Mimoseæ* which have been described with pluricarpellary gynæcea,[3] besides presenting completely regular flowers, have the elements of the gynæceum multiplied in a way which at first sight seems hardly compatible with the single carpel destined to become a solitary pod in most *Leguminosæ*.

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[1] See *Adansonia*, v. 290, 292. Analogous differences are observed in the little group *Pittosporeæ*.

[2] What has just been said of the relations between *Rosaceæ* and *Saxifragaceæ* will apply equally well to *Homalineæ*, which it is very difficult to distinguish absolutely from *Saxifragaceæ*, and which A. L. DE JUSSIEU had, as we have seen, placed among *Rosaceæ*.

[3] Especially *Affonsea* A. S. H., and the curious *Pithecolobium Vaillantii* F. MUELL., which BENTHAM has recently referred to the same genus.

The families with which *Rosaceæ* are also connected, though less nearly, are as follows:—

1. *Ranunculaceæ*; whose perigynous types, such as *Pæonia* and *Crossosoma*, only differ from most *Rosaceæ* in the absence of stipules and the presence of albumen.

2. *Rhamnaceæ*; whose affinities with the *Pyreæ* have long been recognised by very many authors.

3. *Ternstrœmiaceæ* and *Legnotideæ*; of which the *Quillajeæ*, such as *Euphronia* and *Eucryphia*, have more than one feature, notably in the winged compressed albuminous seeds, the plurilocular ovary, and the arrangement of the androceum, especially if we compare these genera with *Bonneticæ*, *Anisophyllea*, *Macarisia*, &c.

4. Finally, *Rutaceæ* and *Simarubeæ*; to which *Rosaceæ* approach very nearly by the curious genus *Rigiostachys*,[1] not to mention the close affinities borne to *Biebersteinieæ* by the *Neuradeæ*, so often included in the order *Rosaceæ*.

The geographical distribution of *Rosaceæ* extends over a very wide area. We find representatives of this order from Lapland to the southernmost points of South America, in every country of the World, or nearly so. The *Chrysobalaneæ* alone are exclusively plants of warm climates. The *Quillajeæ* belong to more temperate regions; they are found from New Mexico to Tasmania; but, except one species indigenous to this last land and Australia, all are American. The other series have representatives in both Worlds; and of the sixty-five genera we have retained, nineteen belong exclusively to the Old World, twenty-three to the New; so that the other twenty-three are common to both. There are twenty-two genera, with only one or very few species each; viz., *Kerria*, *Rhodotypos*, and *Stephanandra*, found only in China or Japan; *Canotia*, *Neviusia*, *Nuttallia*, *Vauquelinia*, *Pterostemon*, *Lindleya*, *Purshia*, *Chamæbatia*, *Coleogyne*, *Fallugia*, each with one species, from North America; *Stranvæsia*, *Maddenia*, *Parastemon*, and *Prinsepia*, each as yet, also only represented by a single species, from India and the Indian Archipelago: so too the single species of the genus *Brayera*

[1] "*Inter* Simarubeas *invenitur, multis notis ad* Rosaceas *accedit.*" (B. H., *Gen.*, 605.)

has only been observed in one part of Abyssinia; the only described *Leucosidea* is peculiar to the Cape; *Bencomia* is only found in the Canaries and Madeira; *Exochorda* in Mongolia; and the two known species of the genus *Adenostema* in California. The two genera *Kageneckia* and *Margyricarpus*, each including two or three species, and *Polylepis*, containing half a score, are peculiar to the Andine region of South America. The two or three known species of *Stylobasium* are Australian. *Trichocarya* is only found in Borneo and Sumatra. Next come genera with a pretty large number of species, still, however, included in relatively narrow geographical limits. *Polylepis* comes again in the category, of which genus, as we have seen, half a score species are admitted, all growing in the temperate Andine regions of Peru, Bolivia, and Columbia; also *Hirtella*[1] and *Licania*, including the one two score, the other upwards of fifty species, confined to the warmest regions of America. From these we pass to the larger genera of the family, such as *Potentilla*, *Fragaria*, *Geum*, *Rubus*, *Rosa*, *Pyrus*, *Cratægus*, *Prunus*, &c., all, it is found, coinciding in the remarkable fact that their species are spread all over the surface of the globe, or at least over a very large extent. Thus, we find Brambles from the north of Europe, Asia, and America to the Cape, New Zealand, and the islands of the Pacific Ocean. The same applies to the Potentils. Roses, again, are found all over the northern hemisphere; while *Acæna* is equally spread over the southern hemisphere from the Cape to Patagonia, and even extends beyond the Equator to Mexico. True, there is great difficulty in ascertaining whether some of the vulgar species of *Geum*, *Fragaria*, *Potentilla*, &c., have not been introduced by man into a large number of countries of which they are not native. This interesting point of geographical botany[2] has been chiefly discussed with regard to our fruit trees, which belong almost exclusively to the order *Rosaceæ*. It is now-a-days generally agreed that some are natives of Europe, others of the East, and that the latter, or at least the greater part of them, have only been introduced in comparatively modern times. Our varieties and races of cultivated Cherries are all considered to have sprung from *Prunus avium* Mœnch and *P. Cerasus* L, the one spontaneous in Europe, the other in the south of Caucasia, and even in the Crimea, Macedonia, and

[1] The only exception in this genus is *H. Thelira*, which comes from Madagascar.

[2] A. DC., *Geogr. Bot. Rais.*, 512, 619, 877, 1102.

Bithynia.[1] So, too, our Plums, sprung from *Prunus domestica* L., and *insititia* L., would come originally from the Caucasus, where both these species are indigenous, and from Greece, where we find the latter.[2] The Apricots of our gardens spring from *P. Armeniaca* L., whose country is indicated by its specific name; it is also said to have been found wild in the neighbouring countries, in Anatolia, and even in Upper Egypt. The Peaches, introduced into Greece and Italy about the first century of the Christian era, descend from *Prunus persica* (*Amygdalus persica* L.), whose specific name also seems to denote its country; but according to A. DE CANDOLLE, it would come from China rather than from Western Asia. The Almond was introduced into Rome from Greece, and is affirmed to grow wild in the mountains south of the Caucasus; but its spontaneity in these localities has been doubted.[3] In Greece it is certainly introduced. Its original country has been supposed to extend "over Persia, Asia Minor, Syria, and even Algeria." As regards the Pear (*Pyrus communis* D.), it is, says A. DE CANDOLLE, "alike spontaneous in temperate Europe and the district of the Caucasus." The same country is ascribed to *P. Malus* L., which seems the source of all our Apples,[4] austere and sweet. The Quince (*Cydonia vulgaris* L.) appears to be spontaneous in certain localities of Europe; this is certainly the case in Greece and Italy. The Raspberry and Strawberry have long been cultivated in our countries, but their European origin has never been doubted; and, as regards their very numerous edible varieties, "no one shrinks from recognising in them the species so common in the temperate regions of Europe and Asia." The Cocoa-plum (*Chrysobalanus Icaco* L.; Fr., *Icaquier*) is the last species of fruit tree which seems to us worthy of special attention. There can be no doubt as to its being a native of Equatorial America. But when we find the same plant or its varieties in different regions of tropical Africa, and in conditions which would seem to prove that it is spontaneously developed there, we may ask ourselves whether

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1 Cherries are said to have been first brought from Pontus to Rome, in the time of Lucullus.

2 The Damson (Fr., *Prune de Damas*) has, however, been supposed to have been brought to Europe during the crusades.

3 "*An vere spontanea?*" LEDEB., *Fl. Ross.*, ii. 3.)

4 In short, all the above enumerated fruit trees, except the Peach, appear to be of Caucasian origin; and on this point, nearly all botanists are agreed according to A. DE CANDOLLE (*op. cit.*, 878–891). I should, however, add, on the authority of THOREL, that he has seen most of our *Rosaceæ* with edible fruits growing wild, and no doubt spontaneous, in the temperate regions extending north-east of Cochin China.

that country is not another natural cradle of the Cocoa-plum; and this question several contemporary writers have answered in the affirmative.[1]

A large number of the *Rosaceæ* are employed in industry, domestic economy, medicine, and horticulture.[2] The property most widely spread in the plants of this order is undoubtedly astringency, owing to the abundance of tannin[3] in their tissues. Accordingly we find that the astringents most frequently employed in every-day medicine belong to the *Rosaceæ*.[4] This is the case with several Roses; thus the Red or Provence Rose,[5] and the Cabbage Rose[6] (Fr., *Rose à cent feuilles, Rose pâle*[7]) contain in their petals a free acid and a large quantity of tannin.[8] The Agrimonies, though not so rich in this substance, were formerly highly prized as astringents, especially *A. Eupatoria*.[9] So with the Alchemils, especially *A. vulgaris*,[10] *alpina*,[11]

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[1] B. H., *Gen.*, 606, n. 1.

[2] ROSENTH., *Syn. Plant. Diaphor.*, 943, 1159.

[3] The *Rosaceæ* have long been known as one of the orders richest in tannin, and C. SANIO had in 1863 made some observations as regards the distribution of this principle in the tissues of *Pyrus*, *Prunus*, and *Amygdalus*. A. TRÉCUL made this question the subject of an important work, read at the *Académie des Sciences* on the 15th of May, 1865 (*Comptes Rendus*, lx. 1035; *Adansonia*, vii. 337), showing that in certain species there is tannin in all the tissues of the branches, epidermis, layers of bark, fibrovascular bundles, and pith. So in certain species of *Rubus* and *Potentilla*, the tannin is found everywhere in small quantities, but is especially abundant in series of special cells. These may form a continuous layer on the surface of the liber region (*Alchemilla*, *Acæna*), both internal and external. On treating the medullary rays with iron salts, they too may turn blue, and unite these concentric layers of tannin-cells. In the pith of the Roses the tannin cells are united into vertical rows, connected by horizontal or oblique rows. In the Brambles we find two types in which they are distributed. *Rubus fruticosus*, *glandulosus*, *laciniatus*, &c., have longitudinal medullary rows, connected transversely by elongated cells, besides two unequal concentric layers of tannin-cells in the bark; while in *Rubus strigosus*, *corylifolius*, &c., there are vertical rows in the cortical parenchyma as well as in the pith, usually without any transverse anastomoses in the latter. In most of the *Fragarieæ* and *Sanguisorbeæ* studied by the author, there are only scattered cortical cells. In certain species of *Spiræa* there is tannin in the epidermis, outside the liber, in the medullary rays, around the pith, or even inside it. As regards the state of the tannin in the *Rosaceæ*, TRÉCUL distinguishes between the case in which it takes a blue colour directly it comes in contact with the iron salt, without any need of exposure to the air, and that in which, especially in the young organs, the cells only become blue or black after being exposed for twelve hours or upwards. The young cells often only take a purplish or rusty tint. Besides, pharmaceutists know that all the *Rosaceæ* do not strike blue with iron salts; the tannin of the Provence Rose especially strikes green.

[4] GUIB., *Drog. Simpl.*, éd. 4, iii. 266.

[5] *Rosa gallica* L., *Spec.*, 704.—*R. cuprea* JACQ., *Fragm.*, t. 34.—*R. pumila* L. FIL, ex RAU., *Enum.*, 112—*R. remensis* DC., *Fl. Fr.*, iv. n. 3708.—*R. burgundica* RŒSS., *Ros.*, t. 4.—*R. officinalis* RED., *loc. cit.*, 73.

[6] *R. centifolia* L., *Spec.*, 301.

[7] The latter name is, according to GUIBOURT, common to the Cabbage Rose and the *Rose de Puteaux*. From it is made the buttery extract which comes from the south of France.

[8] From them are prepared syrups, extracts, conserves, honey, &c. They enter into the composition of honey of Roses, *pommade rosat*, the *mixture cathérétique de Lanfranc*, &c.

[9] L., *Spec.*, 643.—ŒD. *Fl. Dan.*, t. 588.—GUIB., *op. cit.*, 277.—H. BN., *Dict. Encycl. des Sc. Méd.*, ii. 202 (Herb Agrimony, *Francormier* or *Eupatoire des Grecs, des anciens*).

[10] L., *Spec.*, 178.—PEREIRA, *Elem. Mat. Med.*, ed. 4, ii. p. ii. 202.—LINDL., *Fl. Med.* 235.—H. BN., *Dict. Encycl. des Sc. Méd.*, ii. 560 (Lady's Mantle, *Pied-de-lion*, *de-griffon*, *Soubeirette*, &c.).

[11] L., *Spec.*, 179, var. *α*.—*A. argentea* LAMK., *Fl. Fr.*, iii. 303 (*Pied-de-lion satiné*).

Aphanes,[1] &c. The name *Sanguisorba* (Fr., *Sangsorbe*=Blood-stancher) indicates that the plants of this genus were formerly used in the treatment of hæmorrhage, just like the other Burnets of the section *Poterium*; we may cite as the most important *Poterium Sanguisorba*,[2] *Sanguisorba officinalis*[3] and several other species.[4] The leaves of several Brambles, especially *Rubus fruticosus*[5] (Blackberry), also constitute one of the best known astringent simples, like also the rhizome of the *Fragaria vesca*,[6] commonly known as strawberry-root (*racine de Fraisier*), that of the Cinquefoil (*Quintefeuille*),[7] Tormentil[8] (*Tormentille*), Herb Bennet (*Benoîte*),[9] the leaves of the Silverweed[10] (*Argentine*) the root of the Meadow-sweet or Queen of the Meadows[11] (*Ulmaire* or *Reine-des-près*), and the green fruits of many Pears,[12] Hawthorns,[13] and Plums.[14] The same astringent properties

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[1] LEERS, *Herb.*, n. 122.—*A. arvensis* SCOP., *Fl. Carniol.*, i. 115.—*Aphanes arvensis* L., *Spec.*, 179 (Parsley Piert, *Perce-pierre Perchepied*).

[2] L., *Spec.*, 1411.—*Pimpinella Sanguisorba* GÆRTN., *Fruct.*, 162, t. 32. (Garden Burnet, Salad Burnet, *Petite Pimprenelle*, *Bipinnelle*).

[3] L., *Spec.*, 169.—*S. sabauda* MILL., *Dict.*, n. 2 (Great Burnet, *Grande Pimprenelle*, *P. des montagnes*).

[4] *S. media* L., and *canadensis* L., have the same virtues (ENDL., *Enchir.*, 662).

[5] L., *Spec.*, 707. *R. cæsius* (Dewberry) has the same properties. In the north of America, *R. canadensis*, *villosus*, *hispidus* L., serve the same purposes. As many as thirty Brambles are more or less used in medicine (see ROSENTH., *Syn. Pl. Diaph.*, 957-960, 1159).

[6] L., *Spec.*, 705.—DC., *Prodr.*, 569, n. 1.

[7] *Potentilla reptans* L., *Spec.*, 714.—*P. nemoralis* LEHM., *Mon.*, ic. t. 13.

[8] *Potentilla Tormentilla* NESTL., *Pot.*, 65.—*Tormentilla erecta* L., *Spec.*, 716.—*T. officinalis* SM., *Engl. Bot.*, t. 863.—*T. tetrapetala* HALL. F., *Ser. Mus. Helv.*, 51.

[9] *Geum urbanum* L., *Spec.*, 716.—GUIB., *op. cit.*, 282.—H. BN., *Dict. Encycl. des Sc. Méd.*, ix. 81.—*G. canadense* MURR., *rivale* L., *intermedium* EHRN., and *virginianum* L., have the same astringent properties.

[10] *Potentilla anserina* L., *Spec.*, 710 (*Herbe aux oies*). About half a score of Potentils are used in the same ways (ROSENTH., *op. cit.*, 961-963).

[11] *Spiræa Ulmaria* L., *Spec.*, 702.—*S. denudata* PRESL., *Fl. Cech.*, 101.—*S. ulmarioides* BOR., *Voy. Sout.*, 121.—*Ulmaria palustris* MŒNCH, *Meth.*, 663. This plant has played a certain part in chemistry on account of the studies made on the acid oil it contains, which is salicylic hydride, a substance which has also been prepared artificially by the action of sulphuric acid and potassic bichromate on salicine. Several *Spiræas* are used as astringents, such as *S. Aruncus* L. (*Spec.*, 702), *S. Filipendula* L. (*Spec.*, 702);—*Filipendula vulgaris* MŒNCH; Dropwort), and *S. tomentosa* L. (*Spec.*, 701), a species from North America, whose properties are analogous to those of Rhatany.

[12] Including the Service-trees (*Sorbiers*) and Apples (*Pommiers*, p. 392, note 1). The green fruits of the Crab Apple, *Pyrus acerba* DC. (*Malus acerba* MER., *Fl. Par.*, 187), are very austere and astringent. Those of the White Beam (*P. Aria* EHR., *Beitr.*, iv. 20;—*Mespilus Aria* SCOP.;—*Sorbus Aria* CR.;—*Cratægus Aria* var. *a* L., *Spec.*, 681), are employed on this account in the country while unripe, as are those of the Service-tree (*Pyrus Sorbus* GÆRTN., *Fruct.*, ii. 45, t. 87;—*P. domestica* SMITH;—*Sorbus domestica* L.;—*Cormus domestica* SPACH; Fr., *Cormier*, *Sorbier Commun*), of the Mountain Ash or Rowan (*P. aucuparia* GÆRTN., *loc. cit.*;—*Sorbus aucuparia* L.;—*Mespilus aucuparia* ALL.; Fr., *Sorbier aux oiseaux*), rich in malic acid, often extracted from them, and from *P. americana* DC. (*Sorbus americana* PURSH.), and the Wild Service-tree (*P. torminalis* EHR., *S. torminalis* CR.;—*Cratægus torminalis* L.).

[13] Including *Mespilus* (p. 397). It is well known how astringent and austere are the fruits of the Common Medlar (*Cratægus germanica*, *Mespilus germanica* L., *Spec.*, 684;—*Pyrus germanica* B. H., *Gen.*, *loc. cit.*). In the popular medicine of the country we often find used to stop slight attacks of phlegmasia, flux, &c., the Hawthorn (*C. Oxyacantha* L., *Spec.*, 683;—*Mespilus Oxyacantha* GÆRTN., Fr. *Aubépine*), *C. monogyna* JACQ., *C. crusgalli* L., Azerole Thorn (*C. Azarolus* L., Fr., *Azerolier*, Epine d'Espagne), the Fiery Thorn (*C. Pyracantha* PERS.;—*Mespilus Pyracantha* L.;—*Cotoneaster Pyracantha*, SPACH., Fr., *Buisson ardent*). Several North American species are similarly used, especially *C. mexicana* SESS., *parvifolia* AIT., *coccinea* L., *cordata* AIT., &c. (see ROSENTH., *op. cit.*, 950).

[14] It is from the Sloe or Blackthorn (*P. spi-

are found in the barks of several *Rosaceæ*, hence used either in medicine or for tanning or dyeing. The Bird Cherry[1] (Fr., *Putiet, Merisier à grappes*), a tree spontaneous in Europe, has a strong-smelling bark of bitter astringent taste, which has been proposed as a succedaneum to quinine in the treatment of intermittent fevers. The bark[2] of the Virgina Cherry[3] is supposed to be endowed with the same properties. They are met with in *P. Capolina*,[4] a Mexican species, pointed out as a good substitute for quinine. *Margyricarpus setosus*,[5] from Chili and Peru, is also an astringent plant, for in its native country it is used against piles. The *Chrysobalaneæ* share these properties, so widely diffused in the whole order *Rosaceæ*. *Chrysobalanus Icaco*[6] is valued for its root, bark, and leaves, which are considered in Brazil and the neighbouring countries as efficacious in the treatment of diarrhœaic and leucorrhœaic affections, and certain other forms of flux.

It is for the same reason that several *Rosaceæ* serve for preparing hides and dyeing black. The Brazilians obtain this colour by treating the fruits of *Licania glabra* and *heteromorpha* with ferruginous earths. The mesocarp of *Chrysobalanus* and that of *Couepia chrysocalyx* also serve to make a deep black, with which the Indians cover the vases they make from Calabashes and Gourds.[7] In our country a yellow or black dye is obtained from the bark of several *Pyreæ*, especially of the genus *Cratægus;* so with the genus *Photinia*[8] in India. We must also cite as tinctorial species more or less frequently used, the Crab-apple (*Pyrus acerba* DC.), and the White Beam (*P. Aria* Cr.); the Roses when covered with

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nosa L., *Spec.*, 681; Fr., *Prunier épineux, Epine noir*) that was formerly extracted the astringent juice known as *Acacia nostras* [Native Acacia,] substituted for the Egyptian Acacia, and prepared from the very austere nearly globular violet fruit (Guib., *op. cit.*, 290;—Rosenth., *op. cit.*, 972). The Bullace (*P. insititia* L., *Spec.*, 680) served the same purposes; its fruit, more oblong than in the preceding, has an austere bitter taste, almost intolerable. The Κοκκυμηλέα of Dioscorides, of nearly analogous astringent properties, is, according to Tenore (*Prodr.*, *Suppl.*, ii. 67), his *P. Coccomilia*, from Calabria, which has been considered superior to quinine in the treatment of certain marsh affections.

1 *Prunus Padus* L. (*Spec.*, 677;—*Cerasus Padus* DC., *Fl. Fr.*, iv. 580). It is also called *Faux bois de Sainte-Lucie* (fig. 477).

2 *Cortex Pruni Virginiani* of the American pharmacopœia.

3 *P. virginiana* Michx. (*Fl. Bor. Amer.*, i. 285, nec Mill.;—*P. rubra* Ait., *Hort. Kew.*, ed. 1, ii. 162).

4 *Cerasus Capollin* DC., *Prodr.*, ii. 539, n. 29.—Lindl., *Fl. Med.*, 232.—*P. virginiana* Sess. & Moc. (nec Michx.).

5 R. & Pav., *Fl. Per. et Chil.*, i. 28, t. 8, fig. d.—DC., *Prodr.*, ii. 591.—Lindl., *Veg. Kingd.*, 562 (see p. 352, figs. 409, 410).—*Ancistrum barbatum* Lamk., *Ill.*, 77.

6 See p. 415, note 4, figs. 486, 487.—Mart., *Fl. Bras.*, *Rosac.*, 76.

7 Mart., *Fl. Bras.*, *Rosac.*, 76.

8 Especially *P. dubia* Lindl., used in Nepaul as a scarlet dye.

Bedeguars or moss-galls, several Brambles, Agrimonies, and Alchemils, Dropwort, and several other species of *Spiræa*.

Another product of the bark of *Rosaceæ* is gum, whose formation results from a morbid condition[1] in most of our wild or cultivated *Pruneæ*, especially the common Plum, the Apricot, and the two common Cherries. In many of these trees as they grow old it exudes spontaneously from the stem and boughs. This gum (known in France as *gomme de France* or *nostras*), imperfectly soluble in water, in which it swells out considerably, is no longer employed in medicine, and is only used in preparing felt for the hatter. The best known is that found in large quantities in the superficial integument of Quince pips,[2] which is much used as a demulcent in medicine, and in arts and domestic economy for its glutinous properties. Next to gums come the forms of mucilage so abundantly produced in several *Rosaceæ*. Apple and Pear pips may also supply a small quantity of this mucilaginous substance; but it is especially abundant in the barks of the different soap-Quillais, especially *Quillaja Saponaria*,[3] *Smegmadermos*,[4] and *brasiliensis*.[5] It is probably the bark of one of these, perhaps the first, which is often sold in Paris under the name of *écorce de Panama* (Panama Bark). Powdered and mixed with water this substance makes it froth like soap-suds, and gives it the property of removing grease from woollen and silk stuffs.[6]

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[1] See A. TRÉCUL, *Malad. de la Gomme chez les Cerisiers, les Pruniers, les Abricotiers, les Amandiers* (*Compt. Rend. de l'Acad. des Sc.*, li. 621); *Product. de la Gomme chez le Cerisier, le Prunier, l'Amandier, l'Abricotier, et le Pêcher* (*l'Instit.*, xxx. n. 1490, 241). The gum was formerly believed to be secreted by the cells of the inner bark of these plants. It was supposed to be deposited in the outer cellular tissue, and when the bark is finally torn open, to flow out. KUETZING announced in 1851 that the cellulose membranes might be transformed into gum. In 1857 KARSTEN affirmed that all gums and mucilages were the result of some such change. WIGAND, in the first part of his memoir, *Ueber die Deorganis. der Pflanzenz.* (*Pringsh. Jahrb.*, iii. 115), studied the transformation of the tissues of the wood and bark of *Rosaceæ*. TRÉCUL thinks this gum is a purely pathological product extravasated into equally morbid cavities. Under the influence of a too large supply of nourishment the young cells of the generative layer may be absorbed; the vessels may be similarly destroyed, and so form cavities, on the walls of which appears the gum, which thence spreads into the neighbouring anfractuosities. The striæ which have been taken for gum-channels are folds in the cell-membranes. In the Apricot these cells are often dilated, and form necklaces, between the beads of which are septa, which may be more or less completely absorbed. These cavities and those of the woody fibres themselves in certain *Pruneæ* may contain not only gum but also cerasome, a substance which is neither gum nor cellulose, and is not acted upon by iodine or sulphuric acid even after boiling in potash. In the cavities of the sap wood we also find around the true gum another substance, which does not swell up in water, and turns bright pink in contact with iodine and sulphuric acid.

[2] *Cydonia vulgaris* PERS. (p. 395, figs. 463–465). The fruit is the *Cydonia* or *Cotonea* of pharmacopœias and the Κυδώνια of Hippocrates.

[3] MOL., *Chil.*, ed. 2, 298.—*Q.? Molinæ* DC., *Prodr.*, ii. 547, n. 2.

[4] DC., *loc. cit.*, n. 1.—*Q. Saponaria* POIR., *Dict.*, vi. 33 (nec MOL., ex DC.).

[5] MART., *Syst. Mat. Med. Bras.*, 127.—*Fontenellea brasiliensis* A. S. H. & TUL., *Ann. Sc. Nat.*, sér. 2, xvii. 141, t. 7.

[6] This property seems due to a peculiar pungent substance, which BOUTRON & HENRY (*Journ. de Pharm.*, xiv. 247; xix. 4) have found

The *Rosaceæ* are often odoriferous. In the *Pruneæ* this odour is usually that of prussic acid or essence of bitter almonds.[1] These substances, of so high a practical utility, are found in very many species of our genus *Prunus*.[2] The leaves and seeds of most Cherries and Cherry Laurels produce them, especially the common Cherry Laurel of our gardens.[3] *Prunus virginiana*[4] owes similar though less marked therapeutical properties to the presence of the same principles. This too is the case with *P. Capollin* of Mexico and *P. undulata*[5] of Nepaul, which may cause grave accidents; the leaves poison any cattle which may browse on them. The smell of prussic acid is found in the leaves of *Nuttallia cerasiformis*,[6] and in the seeds of most of our Peaches, Apricots, Plums, and Cherries; this accounts for the peculiar perfume of the well known liquors into the preparation of which some of these plants enter.[7] This will also explain how it is that tea is often adulterated with the leaves of the sloe (*Prunus spinosus*) and wild Cherry (*P. avium*); how too the Bird Cherry (*P. Padus*; Fr., *Putiet*) may possess the same medicinal virtues as the Cherry Laurel, though in a less degree;[8] and how Peach-blossom, administered as a gentle

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in Quillai-bark, united with chlorophyll, fatty matter, and sugar; it froths a great deal in water, and presents the general properties of saponine and salseparine (see GUIB., *Drog. Simpl.*, éd. 4, iii. 285;—LINDL., *Veg. Kingd.*, 564;—ROSENTH., *op. cit.*, 970).

[1] These almonds are the seed of a variety *a* (*Amara* DC., *Fl. Fr.*, iv. 486;—DUHAM., *Arbr.*, ed. 2, 114) of *Prunus Amygdalus* (*Amygdalus communis* L.), a variety which, apart from the peculiar taste of the seed, is distinguished by a style of nearly the same length as the stamens, and tomentose below. The seeds contain synaptase (ROBIQUET) or emulsine (LIEBIG), and amygdaline ($C^{40}H^{27}O^{22}N$ or $\mathbf{C^{20}H^{27}NO^{11}}$). It is the latter which in several economic or pharmaceutical operations is converted in presence of water [and the former substance] into a certain quantity of glucose ($C^{12}H^{12}O^{12}$ or $\mathbf{C^{6}H^{12}O^{6}}$), cyanhydric acid ($C^2HN$ or $\mathbf{CHN}$), and oil of bitter almonds ($C^{14}H^6O^2$ or $\mathbf{C^7H^6O}$).

[2] See pp. 403–410.

[3] *Laurier-Amande, Laurier Cerise.*—*Prunus Laurocerasus* L., *Spec.*, 678.—*Cerasus Laurocerasus* LOISEL., in DUHAM., *Arbr.*, éd. 2, v. 6.—DC., *Prodr.*, ii. 540, n. 36.—GUIB., *op. cit.*, iii. 293, fig. 329.—A. RICH., *Elém. d'Hist. Nat. Méd.*, éd. 4, ii. 257.—PEREIRA, *Elem. Mat. Med.*, ii. p. ii. *loc. cit.*—LINDL., *Fl. Med.*, 232.—ROSENTH., *Syn. Pl. Diaphor.*, 978.—MOQ., *Bot. Méd.*, 188, fig. 59 (see p. 409, fig. 483). This species, a native of Trebizond, introduced into Europe in 1576, is abundantly cultivated in this country [in England as well as in France]. Its leaves serve to give an aromatic flavour to milk and other liquids. The only preparation used in medicine is the distilled water (Laurel-water), impregnated with volatile oil and cyanhydric acid. The plant is dangerous, and should only be used cautiously.

[4] *P. rubra* AIT.—*Cerasus virginiana* MICHX. (see p. 439, note 3). Its leaves and green bark are sedative, but poisonous in an overdose.

[5] HAM., ex DON., *Prodr. Fl. Nepal.*, 239.—*P. capricida* WALL.—*Cerasus undulata* SER., ex DC., *Prodr.*, ii. 540, n. 31.—ENDL., *Enchir.*, 663.

[6] See p. 413, note 6.

[7] Especially *Kirschwasser*, prepared in Switzerland, the Vosges, Jura, &c., from the flowers of the Wild Cherry (*Prunus avium* L., *Spec.*, 679;—*P. nigra* MILL., *Dict.*, n. 2 (nec AIT.);—*Cerasus avium* MŒNCH., *Meth.*, 672;—Fr. *Merisier*), and preferably of the large fruited variety called *macrocarpa* (SER., in DC., *Prodr.*, ii. 535, n. 2, *β*;—DUHAM., *Arb. Fr.*, i. 180); Cherry, Plum, and Damson wine, and finally, noyau, which is flavoured with the seeds of several species of *Armeniaca* and *Prunus*, especially *P. sphærocarpa* SWEET, and *occidentalis* SWEET (LINDL., *Veg. Kingd.*, *loc. cit.*;—ROSENTH., *op. cit.*, 979).

[8] The fruits are bitter and nauseous. The

purge, may at the same time kill intestinal worms, and may even produce mortal accidents in man.[1] Prussic acid is also found in several of the Pear group, especially in the seeds of *Pyrus*, *Malus*, *Cotoneaster microphylla* and *C. Uva ursi*. The root, bark, and flower of the Mountain Ash or Rowan (*Sorbier des oiseaux*) may, we are assured,[2] yield as much of this acid as an equal weight of Cherry Laurel leaves.

There are some *Rosaceæ* which are dangerous or medicinal without their active principle being prussic acid, or even the nature of that principle being known. Thus, it is not known why several Burnets have bitter nauseous emetic roots, while their fruit is a narcotic poison; why *Rubus villosus*,[3] so much used in America as an astringent, is also emetic in a large dose;[4] why *Gillenia trifoliata*[5] and *stipulacea*,[6] of the United States, act in the same way as ipecacuanha; why the wood of the Quillai, whose saponaceous properties we have described, irritates the mucous membrane of the nasal fossæ very strongly, causing violent sneezing;[7] or why the *Indian Chocolate-root*[8] of the United States, acts as an alterative in affections of the abdominal viscera. The cause of the vermicidal action of several *Rosaceæ* is thought to be better known; some of these, such as *Agrimonia Eupatoria* L., are used to destroy round or thread worms, others for tape-worm, like the celebrated Kousso of Abyssinia,[9] which is only the flower of *Brayera abyssinica*.[10]

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bark varies in properties with its age. Towards the end of the year it is bitter, astringent, and tonic, while in spring it is acrid, with a smell of bitter almonds, and on distillation yields a water containing cyanhydric acid (Endl., *Enchir.*, 663;—Rosenth., *op. cit.*, 978;—Guib., *op. cit.* 293).

[1] Lindl., *Veg. Kingd.*, 558.

[2] Buchn., *Rep.*, 27, 238.

[3] Ait., *Hort. Kew.*, ii. 210.—DC., *Prodr.*, ii. 563, n. 71.

[4] Glandular reddish hairs, covering most of the vegetative organs, secrete a viscid liquid, with a resinous smell like turpentine, which renders the plant poisonous. The bark of the root is an energetic astringent drug. Chapman considers this one of the most active and efficacious remedies in diarrhœa, infantile cholera, &c. (Bigel., *Med. Bot.*, ii. t. 38;—Lindl., *Fl. Med.*, 227).

[5] Mœnch, *Meth.*, *Suppl.*, 286.—DC., *Prodr.*, ii. 546.—Bigel., *op. cit.*, iii. t. 41.—Pereira, *Elem. Mat. Med.*, ed. 4, ii. p. ii. 282.—Lindl., *Fl. Med.*, 229.—*Spiræa trifoliata* L., *Spec.*, 702. It is the false Ipecacuanha of North America of Guibourt (*Drog. Simpl.*, éd. 4, iii. 89).

[6] Nutt., *Gen. Amer.*, i. 307.—Barton, *Med. Bot.*, 71, t. 16.—Lindl., *loc. cit.*

[7] Perhaps because of the peculiar crystals so much developed in the bark, and terminating in a point at each end.

[8] Or *Blood-root*. This is supposed to be *Geum canadense* Jacq. Its leaves and root are much used as tonics in Prince Edward's Island. They are bitter, and useful in infantile diarrhœa (see *Med. Bot. Trans.* (1829), 8).

[9] Or *Kosso*, the Amharic name of the plant, which is called *Kossish* in Gafat, *Kosbo* in Gonga, *Hhabbe* in the Tigré, *Sika* in Waab, *Turo* or *Skinei* in Agau-mider, *Sakikana* in Falasha, *Bêti* in Galla (see Pereira, *Elem. Mat. Med.*, ed. 4, ii. p. ii. 296).

[10] Moq. (see pp. 343, 344, figs. 388-392). It was first mentioned by Godingus (*De Abyss. Reb.*, lib. i. cap. 2), in 1645, according to Leutholff, as curing the worms caused by the use of raw meat in Abyssinia. It was studied and described by Bruce in 1790 under the name of *Banksia abyssinica*. The younger Linnæus having already made a genus *Banksia*, Lamarck named the plant *Hagenia* in 1811 (*Ill.*, t. 311), and Willdenow and Sprengel admitted this last generic name, though it had previously been applied to several other genera. In 1823 Brayer

The other odours extracted from *Rosaceæ* are due to essential volatile oils; the most famous is undoubtedly the essence or otto of Roses, extracted from the petals of a certain number of species of the genus *Rosa*, especially *R. centifolia, damascæna, indica, sempervirens,* and *moschata,* which are far less perfumed in these countries than in India, Persia, and Tunis, where the essence is prepared in various ways.[1] It is known in Persia as *Atar, Ather* of Roses, or *Ather-gul;* it very rarely arrives free from adulteration in our countries. It is to the presence of this essence that Rose-water, so much employed in pharmacy, owes its peculiar odour. The flowers and roots of several *Spiræas*[2] are also very odoriferous; the petals of the Agrimonies have a fruity odour, and *Agrimonia odorata*[3] possesses this perfume in nearly all its parts; Herb Bennet[4] owes its old name of *Caryophyllata* to the smell of its rhizome, and we all know the sweet scent given off in spring from Apples, Hawthorns, Peaches, and Plums, when in blossom.

The seeds of several *Rosaceæ* are rich in fixed oil; the best known is that of the sweet Almond,[5] which the presence of this fat substance fits for making emulsions, *orgeat*, mucilaginous confections,

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sent KUNTH specimens of *Kousso*, which drug had been attributed in France to *Agrimonia orientalis* T. (*Mém. de l'Acad. de Médec.*, i. 470). The work of BRAYER, in which *Brayera* was published, dates from 1823 (*Notice sur une Nouv. Pl. de la Fam. des Rosac.*). FRESENIUS (*Mus. Senkenb.*, ii. 162) was the first to recognise the identity of *Hagenia* and *Brayera*, which BUCHNER (*Rep.*, ii. bd. xviii. s. 367), has named, no doubt through some accidental error, *Bracera anthelminthica. Kousso* was afterwards studied by MÉRAT (*Bull. de l'Acad. de Méd.*, vi. 492), and A. RICHARD (*Tent. Fl. Abyss.*, i. (1847), 258; *Elém. d'Hist. Nat. Méd.*, éd. 4, ii. 250). Even at the present moment the fruit is, as we have stated, quite unknown (see GUIB., *Drog. Simpl.*, éd. 4, iii. 284;—LINDL., *Fl. Med.*, 230;—ROSENTH., *loc. cit.*). BEDALL states that the active principle is koussine ($C^{26}H^{22}O^5$).

1 See KÆMPF., *Amœn. Exot.*, 276.—MER. & DE LENS., *Dict. de Mat. Méd.*, vi. 111.—GUIB., *op. cit.*, 275.—*Journ. de Pharm.*, v. 232; vi. 466; vii. 527; xv. 345; xviii. 641.

2 *Spiræa Aruncus* L. (*Spec.*, 782;—DC., *Prodr.*, n. 29;—*Barba Capræ* off.) has a powerfully-scented bitter root, formerly employed as a febrifuge. All the parts of the Meadow Sweet (*Spiræa Ulmaria* L., *Spec.*, 702;—*Ulmaria palustris* MŒNCH, *Meth.*, 663) smell of bitter almonds. Dropwort (*S. Filipendula* L., *Spec.*, 702; *Filipendula vulgaris* MŒNCH; Fr., *Filipendule*) is the *Saxifraga rubra* of old herbals. The swelling on its roots, besides being edible, as we shall see a little later, contains a bitter aromatic substance. They have been recommended in hydrophobia (ROSENTH. *op. cit.*, 968). The following other species have also been used as astringents:—*S. tomentosa* L. (*Spec.*, 701;—DC., n. 23), the *Hardback* of North America, *S. opulifolia* L. (*Spec.*, 702;—DC., *Prodr.*, n. 1), the *Nine-bark* of North America, which is a *Neillia* in the eyes of BENTHAM & HOOKER (see p. 390); the *Schelamanik* of Kamtschatka, or *S. kamtchatica* PALL. (*Fl. Ross.*, i. 41;—DC., *Prodr.*, n. 33); and *S. chamædrifolia* L., *crenata* L., *altaica* L., and *salicifolia* L., sometimes mixed with the tea imported from China.

3 CAMER., *Hort.*, 7, ex DC., *Prodr.*, ii. 587, n. 2.

4 *Geum urbanum* L., *Spec.*, 716.—DC., *Prodr.*, ii. 551, n. 9.—PEREIRA, *op. cit.*, 281.—H. BN., *Dict. Encycl. des Sc. Méd.*, ix. 84, n. 1 (*Radix Sanamundæ* off.).

5 *Prunus Amygdalus*, var. *amara* (*Amygdalus communis* L., *Spec.*, 677, *a amara* DC., *Fl. Fr.*, iv. 486; *Prodr.*, ii. 530, n. 1).—GUIB., *op. cit.*, iii. 288.—PEREIRA, *op. cit.*, 243.—LINDL., *op. cit.*, 231.—ROSENTH., *op. cit.*, 970.—H. BN., *Dict. Encycl. des Sc. Méd.*, iii. 483.

&c. The seeds of the Apricots also contain a sweet oil, especially those of the Briançon Apricot,[1] from which is extracted "*huile de marmottes*," employed for the same purposes as olive-oil, while the cake serves to fatten cattle. The fixed oil extracted from the pips of Apples, Pears, and Quinces is not sufficiently copious to be at all extensively used. From the seeds of *Prinsepia utilis* is obtained an edible oil, and several *Chrysobalaneæ* are prized for the same purpose in Brazil and other countries.

The wood of the trees of this order is not without its industrial value. That of the Pear has a fine close grain; but it is less compact, stronger, and more durable than that of *Cratægus*. That of the Crab Apple (*P. acerba* DC.) is very beautiful, like that of the Mountain Ash, which takes a fine polish and is used by the cabinet-maker. The woods of the White Beam (*Cratægus Aria* L.), Wild Service Tree (*C. torminalis* L.), Medlar (*C. germanica*, *Mespilus germanica* L.), Hawthorn (*C. Oxycantha* L.), of *C. orientalis* Bieb., and *tanacetifolia* Pers., several Roses, *Kageneckia*, the Bullace (*Prunus insititia* L.), Cherry (*P. cerasus* L.), and Bird Cherry (*P. avium* Mœnch), are all used and more or less prized for cabinet-work, that of the wheelwright, and for various domestic uses. Walking-sticks are made from the branches of the Blackthorn (*P. spinosa*, L.) and several species of *Cotoneaster*.

Several *Rosaceæ* produce mechanical injuries by their spines or prickles. The fruits of the Agrimonies and several species of *Acæna* hook on to the skin by the recurved prickles with which the indusium is covered. *Acæna Sanguisorba* is dreaded by the Tasmanian colonists because of the wounds which these inflict on their feet, and every one is familiar with those due to the sharp hooked prickles of the Brambles and Roses. With the wild Plums, Almonds, and Hawthorns, *Prinsepia*, &c., these wounds are caused by solid spines resulting from the transformation of more or less abortive axillary branches, which explains the value of the Hawthorn and Azerole in making quick-set hedges. Among these mechanical actions we must also class the intense irritation caused by the hairs covering the inside of the receptacle and part of the achenes in the Hip or fruit of the Rose.

[1] *Prunus brigantiaca* Vill., *Dauph.*, iii. 535.—*Amygdalus brigantiaca* Pers., *Enchir.*, n. 36.—DC., *Prodr.*, ii. 532, n. 1.—Guib., *op. cit.*, 287.—Rosenth., *op. cit.*, 975.—H.Bn., *Dict. Encycl. des Sc. Méd.*, i. 205.

There is no natural order which contains a larger number of plants useful for their fruits, whether for the pericarp or seed; we need only call attention generally to the fact that to *Rosaceæ* belong the numerous species and varieties of Pears,[1] Apples, Quinces, Medlars, Service-fruit (*Sorbes, Cormes*), Plums, Almonds, Cherries, Apricots, Peaches, Nectarines, Strawberries, and Raspberries, cultivated in our gardens, and served daily on our tables. The edible flesh of Apples or Pears, formed to a great extent by the hypertrophy of the receptacular sac, is more or less austere and rich in tannin, or sweet and gorged with saccharine matter. This last can be extracted from the fruit, its fermentation yields alcoholic drinks, like cider and perry. The ripe fruits of several species of *Cratægus*, such as *C. Aria*,[2] *Azarolus*, *latifolia*, *torminalis*, &c., have a pretty sweet or subacid flesh, and may be eaten; but the Service-berries and Medlars are on the contrary, so austere that they are unfit for eating till they are soft and bletted (*vulgo*, sleepy), when they acquire a pleasant, sweet vinous flavour. The fruit of the Mountain Ash is also at first austere, but afterwards sour, owing to the acid found in the fruits of all the above *Pyreæ* being far more copious in this plant. Accordingly this acid (wrongly called *sorbic*, for it is merely malic acid) is pretty frequently extracted from the drupes of *Sorbus aucuparia*.[3] In *Cydonia*[4] the astringency of the mesocarp is also well developed. This flesh, of a very pleasant odour in the Common Quince (*Cydonia vulgaris*), but nauseous in *C. japonica*,[5] is rich in tannin, and has hence been used in medicine. On being cooked with sugar it becomes sweet and gives an agreeable flavour to the jellies, syrups, and pastes prepared from Quinces. The Plums too may, as we have seen, have austere astringent flesh; this is especially the case with the sloe and wild bullace (*Prunus spinosa, insititia*). The different races of cultivated Plums have on the contrary, fruits with sweet perfumed juice. They are eaten raw, cooked, in preserves or marmalades, or dried, whether by stove or sun, either as dessert prunes (*pruneaux de dessert*) or medicinal prunes (*pruneaux à médecine*); the latter are laxative and are prepared from certain particular varieties. A wine and spirit are also obtained

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[1] DECNE., *Jard. Fruit. du Mus.*

[2] *Pyrus Aria* EHRH., *Beitr.*, iv. 20.

[3] GUIB., *op. cit.*, 270.—ROSENTH., *op. cit.*, 947.

[4] GUIB., *op. cit.*, 267.—PEREIRA, *op. cit.*, 303.—LINDL., *Fl. Med.*, 234.

[5] PERS., *Enchir.*, ii. 40.—DC., *Prodr.*, ii. 638.—*Pyrus japonica* THUNB., *Fl. Jap.*, 207?—*Chænomeles japonica* LINDL. (see p. 395, notes 6, 7).

from the Plum, like the liquors extracted from the various kinds of Cherries, under the names of ratafia and kirsch. Cherry syrup and paste, the fruits stewed, or preserved in sugar or spirit, are as well known as the refreshing qualities of the fresh acidulous or sweet fruits of the different varieties. The flesh of *Cerasus Mahaleb*[1] is austere and bitter, but its sweet perfumed seeds, formerly used in medicine, are still sold for perfumery. Apricots and Peaches are eaten fresh, or prepared in various ways; the flesh is considered depurative. Of the Sweet-almond, the only part eaten is the embryo, fresh or dried; that of the Bitter-almond is used for domestic purposes, in perfumery, and as we have seen, in medicine. The edible part of the fruit of the Brambles, is the mesocarp of the numerous drupels collected on one common receptacle; this is hard and whitish, and easily separates from the succulent drupes: their pulp is acidulous in *R. Chamæmorus*[2] (Cloudberry) and *odoratus*,[3] which are eaten in Siberia, and the North of America, as in other sub-arctic regions. Blackberries (*Mûre des haies*, lit., *Hedge Mulberry*) are the fruit of *R. fruticosus, cæsius* [strictly the Dewberry], &c., sweet and sub-acid, and poor in astringent matter, which is on the contrary abundant in the leaves; Blackberry syrup is however sometimes prescribed in slight inflammations. The Raspberry (*R. idæus*[4]—Fr., *Framboisier*) is the *Rubus* most in use for its leaves as well as its fruits, but especially the latter, which have a sweet acidulous perfumed taste. They are very refreshing, and from them are obtained the juice, often administered in fever, and a syrup, alcoholate, and the well known aromatic raspberry vinegar. Though the true fruits of the Strawberry are not achenes, but drupes with thin mesocarps, the edible portion of these plants is the sweet perfumed pulpy hypertrophied receptacle; it is used for its refreshing properties, and the ancients valued it as one of the best blood-purifiers known. The *Chrysobalaneæ* have also often good fruits; and in the first place comes *Chrysobalanus Icaco L.*,[5] whose fruit, vulgarly known as the Cocoa-plum (*Prune-coton, P. des anses*), is eaten all over tropical Africa

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[1] MILL., *Dict.*, n. 4.—DC., *Fl. Fr.*, iv. 480; *Prodr.*, ii. 539, n. 25.—*Prunus Mahaleb* L., *Spec.*, 678.—GUIB., *op. cit.*, 292 (*Bois de Sainte-Lucie*).

[2] L., *Spec.*, 708.—DC., *Prodr.*, n. 87.—GUIB., *op. cit.*, 280. — *Morus norregica* TILLAND., *Abæns.*, 47.

[3] L., *Spec.*, 707.—DC., *Prodr.*, n. 91.—GUIB., *op. cit.*, 280.—ROSENTH., *op. cit.*, 960.

[4] L., *Spec.*, 706.—DC., *Prodr.*, n. 22.—GUIB., *op. cit.*, 279.—*R. frambœsianus* LAMK., *Fl. Fr.*, iii. 135.

[5] *Spec.*. 513.—DC., *Prodr.*, ii. 525, n. 1.—*C. pellocarpus* MIQ., *Prim. Fl. Esseq.*, 193.—*C.*

and America: this fruit is sweet, but with an astringent aftertaste, which is found in a greater degree in the root, bark, and leaves. All these parts are used in America for different kinds of flux, such as diarrhœa, leucorrhœa, and certain hæmorrhages; oil is contained in the embryo. This too is the case with that of several species of *Couepia* and *Parinari*. In *P. senegalense*,[1] this oil soon turns rancid and fœtid; in the Brazilian species it may be used in food. The *Couepias* of the same country have an edible mesocarp, especially *C. guianensis*[2] and *chrysocalyx*.[3] The fruits of *Parinari montana* and *P. campestre*[4] are also eaten in Guiana: the drupes of *P. senegalense* are sold in market at St. Louis; the flesh is juicy but rather austere. That of *P. excelsum*[5] is far preferable; that of *Licania incana*, from Guiana, is sweet and melts in the mouth. Among the edible products of the *Rosaceæ* we may also cite the fruits of several species of *Amelanchier, Osteomeles, Raphiolepis,* and especially the Loquat;[6] the leaves of the Burnets and several Alchemils; the root of Meadow Sweet (*Ulmaire*), the fleshy swellings on that of Dropwort (*Filipendule*), and even the fleshy receptacle enclosing the true fruits of the Roses. In the wild Rose or Eglantine[7] (*Eglantier*), the fruits with their envelopes constitute Hips (*Cynorrhodons*, figs. 377, 378), which are smooth, ovoidal, coral red, and may or may not be crowned by the withered sepals. The flesh of the receptacle is of a more or less reddish yellow colour; from it is prepared *Conserve of Hips*. In very many countries these fruits are supposed to share in the property of curing hydrophobia, ascribed, though quite wrongly, to the stem and especially the root of the Eglantine.

The fruits of the *Rosaceæ* are also the ornaments of our parks and gardens; we may particularize the Service-trees and Hawthorns, and the Fiery Thorn. The flowers are yet more frequently valued for the same end; and omitting *Chrysobalaneæ*, nearly all the Rosaceæ will

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ellipticus SOL., ex SAB., *Trans. Linn. Soc.*, v. 453.—MART., *Fl. Bras.*, *Rosac.*, 76.

1 PERR., DC., *Prodr.*, ii. 527; *Fl. Sen. Tent.*, 273, t. lxi.—*Néou* ADANS., ex J.

2 AUBL., *Guian.*, i. 521, t. 207.

3 BENTH., in *Exs. Spruc.*, ex HOOK. F., in *Mart. Fl. Bras.*, *Rosac.*, 42.—*Moquilea chrysocalyx* PŒPP. & ENDL., *Nov. Gen. et Spec.*, i. 75, t. 286, C.

4 AUBL., *op. cit.*, 514, t. 204–206.

5 SAB., *Trans. Linn. Soc.*, v. 451.—RICH., GUILL. & PERR., *Pl. Seneg. Tent.*, i. 274, t. lxii. (*Rough-skinned* or *Grey Plum* of the English colonists;—*Mampata* ADANS., ex J.).

6 *Eriobotrya japonica* LINDL., *Trans. Linn. Soc.*, xiii. 102.—*Cratægus Bibas* LOUR., *Fl. Cochinch.*, i. 391.—*Mespilus japonica* THUNB., *Fl. Jap.*, 206.—ROSENTH., *op. cit.*, 949.

7 L., *Spec.*, 704.—DC., *Prodr.*, ii. 613, n. 75. —GUIB., *op. cit.*, 272.—ENDL., *Enchir.*, 661.—LINDL., *Veg. Kingd.*, 564; *Fl. Med.*, 220.—PEREIRA, *op. cit.*, 287.—ROSENTH., *op. cit.*, 955.

grow in the open air in our climate. From early spring our parterres are magnificently adorned by the simple or double flowers of various species of Pear, Apple, Quince, Cherry, Plum, Almond, Peach, *Spiræa*, and *Kerria*. The Hawthorns, Service-trees, *Cotoneaster*, the eastern species of *Geum* and *Potentilla*, even *Gillenia* and the Agrimonies, blossom in our gardens; and the Roses still retain their place in the eyes of many besides artists and poets, as the sweetest, the most beautiful of flowers.

GENERA.

I. ROSEÆ.

1. **Rosa** T.—Flowers regular hermaphrodite; receptacle urceolate or ventricose, throat constricted. Calyx 4–5-leaved; leaves entire dentate or pinnatisect, deciduous or persistent; præfloration imbricate, usually quincuncial. Petals 4, 5, shortly unguiculate, imbricate, usually deciduous. Disk lining receptacle glandular, very often silky; mouth thickened into a ring almost closing receptacle. Stamens ∞, ∞-seriate; filaments free inserted outside ring of disk; anthers 2-celled introrse, dehiscing longitudinally. Carpels ∞, rarely few, inserted near bottom of receptacle, sessile or stipitate; styles subterminal, or more frequently more or less ventral, exserted, free or united together into a single mass; apex capitate stigmatiferous; ovules 1, 2 in each ovary, suspended on ventral angle, one usually rudimentary abortive; micropyle superior extrorse. Fruit multiple; achenes ∞, included in baccate receptacle, glabrous or silky or bearded on both sides, or more usually on that next the style. Seed pendulous; testa membranous; embryo thick fleshy; radicle superior; cotyledons plano-convex.—Shrubs, erect sarmentose or climbing, usually aculeate, glabrous silky or glandular-pilose; leaves alternate imparipinnate, more rarely 1-foliolate, or efoliolate with leafy stipules; leaflets usually serrate; stipules adnate to sheathing base of petiole; flowers solitary or in subcorymbose cymes. (*All temperate and subalpine regions.*) See p. 335.

II. AGRIMONIEÆ.

2. **Agrimonia** T.—Flowers hermaphrodite; receptacle turbinate, constricted in throat, bearing outside hooked prickles or 5 alternisepalous (stipulaceous) bractlets. Calyx 5-partite, finally valvate. Stamens 5 alternipetalous, or ∞ in 5 alternipetalous sets, free, inserted in mouth of receptacle. Disk lining receptacle; margin thickened contracted. Carpels 2, 3, sessile, inserted in bottom of receptacle;

ovary 1-celled ; style terminal exserted, apex capitate stigmatiferous ; ovule solitary descending ; micropyle superior extrorse. Achenes 1–3, 1-seeded, included in hardened, often aculeate burr-like receptacle. Seeds exalbuminous ; embryo fleshy, radicle superior.—Perennial herbs ; leaves alternate imparipinnate ; stipules adnate to base of petiole ; flowers in terminal or axillary racemes ; pedicels bracteolate ; bracts rarely (*Aremonia*) connate into a multifid infundibuliform involucre under the unarmed flower. (*Temperate regions of Northern Hemisphere and South America.*) See p. 339.

3. **Leucosidea** Eckl. & Zeyh.—Flowers hermaphrodite 5–6-merous ; receptacle obconical (of *Agrimonia*), glabrous outside, lined by a disk with a thickened mouth. Calyx valvate, with 5–6 alternisepalous stipulaceous leaves (of calycle) outside. Petals short caducous. Stamens 10–12 ; anthers introrse (of *Agrimonia*), thickened and glandular on back. Carpels 2–4 and ovules of *Agrimonia.* Achenes 1–4, 1-seeded, included in glabrous subosseous receptacle.—A silky-villous shrub ; leaves alternate imparipinnate ; stipules adnate to sheathing base of petiole ; flowers 2-bracteolate in terminal spikes. (*Cape of Good Hope.*) See p. 343.

4. **Brayera** K.—Flowers polygamo-diœcious, 4–5-merous ; receptacle turbinate ; throat narrowed by a more or less prominent membranous ring. Calyx persistent ; sepals membranous veined, shorter than exterior alternating bractlets (of calycle). Petals linear or very short obtuse, more rarely 0. Stamens not exceeding 20 (of the *Rosaceæ*), free, inserted in throat of receptacle, in female flowers small sterile. Carpels 2, 3 ; styles terminal, apex widely-dilated stigmatiferous. Ovule solitary descending ; micropyle superior extrorse. Fruit ? . . . .—A tall tree ; leaves alternate crowded interruptipinnate ; stipules large adnate for some distance to petiole ; flowers very numerous crowded axillary racemoso-cymose ; ramifications axillary to leafy bracts ; 1–4 membranous bracts at base of flowers. (*Mountain districts of Abyssinia.*) See p. 343.

5. **Alchemilla** T.—Flowers hermaphrodite 4–5-merous, apetalous ; receptacle urceolate, constricted in throat. Sepals valvate ; outer leaves (of calycle) as many, alternating smaller. Stamens 1–5, alternating with sepals, inserted on throat of receptacle ; filaments free,

inserted around thickened margin of disk lining receptacle, articulated below their apices; anthers terminal dehiscing longitudinally. Carpels 1–4, sessile or stipitate; ovary 1-celled; style basilar or ventral, apex capitate stigmatiferous. Ovule solitary, incompletely anatropous; raphe short descending; micropyle superior extrorse. Achenes 1–4, included in membranous receptacle; seed exalbuminous, embryo thick fleshy; radicle short superior.—Perennial or annual herbs; leaves alternate lobed digitate or palmatipartite, more rarely multifid; stipules adnate to sheathing petiole; flowers minute in dense axillary or terminal corymbose cymes, more rarely few or solitary. (*Andine South America, temperate and cold regions of Northern Hemisphere India North America and Australia.*) See p. 345.

6. **Sanguisorba** L.—Flowers polygamous or hermaphrodite; receptacle sacciform of variable depth, lined by a disk with a thickened or cushion-like edge closing narrow throat of receptacle to a variable extent. Calyx inserted in throat; sepals 4, more or less petaloid, decussate imbricate in præfloration; 2 lateral exterior. Stamens either definite, usually 4 superposed to petals, or ∞; filaments free inserted in throat, either short erect, or elongated filiform corrugated flaccid; anthers didymous introrse. Carpels 1–4, included in receptacle, free from each other; ovary 1-ovulate; ovule descending; micropyle superior extrorse; style terminal, at apex dilated penicillate aspergilliform stigmatiferous. Achenes coriaceous, usually solitary, included in hardened 4-gonous smooth or rugose, more rarely muricate or 4-winged, receptacle; seed descending exalbuminous; radicle of fleshy embryo superior.—Herbs, perennial or very rarely annual, or spiny shrubs; leaves alternate imparipinnate; stipules lateral, adnate to sheathing petiole; flowers capitate or spicate, terminal; peduncles naked for a long way at base solitary or cymose; flowers 2-bracteolate. (*All warm and temperate regions of Northern Hemisphere.*) See p. 347.

7. **Polylepis** R. & Pav.—Flowers hermaphrodite; sacciform receptacle and disk of *Sanguisorba*. Sepals 3–5, sometimes imbricate, usually finally valvate. Stamens 4–∞ (of *Sanguisorba*); filaments short erect. Carpel 1, more rarely 2, 3, and achenes and seeds of *Sanguisorba*; receptacle hardened angular spiny or winged around included fruit.—Trees or shrubs; naked branches tortuous, silky or

villous; leaves alternate 3-foliolate or imparinnate; petioles broad membranous sheathing stipulaceous at base; flowers bracteate in interrupted slender pendulous racemes. (*Peru, Bolivia, Andine Colombia.*) See p. 350.

8? **Bencomia** Webb.—Flowers diœcious; receptacle of males minute scarcely concave, of females sacciform, constricted in throat. Calyx 3–5-phyllous imbricated. Stamens ∞, free; filaments filiform tortuous; anthers introrse ovate-rotundate, in female flower 0. Carpels 2–4 (of *Sanguisorba*), included in receptacle. Fruits and seeds of *Sanguisorba*; carpels included in finally drupaceous receptacle.—Bushy shrubs; leaves alternate imparipinnate; stipules adnate to sheathing base of petiole; flowers sessile 2-bracteolate, arranged in long pedunculate axillary spikes. (*Canary Islands, Madeira.*) See p. 351.

9. **Acæna** Vahl.—Flowers hermaphrodite; receptacle sacciform, obconical or turbinate, terete or angulate, naked tuberculate or with hooked prickles, constricted in throat, lined by a glandular disk. Calyx 3–8-phyllous, slightly imbricated in præfloration. Stamens 1–10, inserted in throat of receptacle, one or more free in front of each petal. Carpels 1, 2, included in receptacle; ovary 1-ovulate (of *Sanguisorba*); style subterminal, apex stigmatose, peltate or dilated, fimbriate. Achenes awned or spinescent included in smooth or tuberculate hardened receptacle; seed pendulous, radicle of fleshy exalbuminous embryo superior.—Herbs, usually suffrutescent at base, decumbent or erect, smooth or silky; leaves alternate imparipinnate; stipules adnate to sheathing base of petiole; flowers bracteate, in interrupted spikes or heads at summit of scape-like branches. (*Chili, Peru, temperate and cold regions of Southern Hemisphere, New Zealand, Australia, Sandwich Islands, California, South Africa.*) See p. 351.

10. **Margyricarpus** R. & Pav.—Flowers hermaphrodite; receptacle ovoidal or compressed-4-gonous, winged or slightly tuberculate, lined by a disk closing throat. Sepals 3–5. Petals 0. Stamens 2, 3 (of *Acæna*). Carpel 1 (of *Sanguisorba*); style at apex dilated penicillate stigmatiferous. Achene 1, included receptacle; baccate glabrous or slightly tuberculate under the apex, rarely 4-alate (*Tetraglochin*). Seed of *Sanguisorba*.—Shrubs, bushy rigid; leaves alter-

nate imbricated 2-morphous, either imparipinnate with a spinescent midrib, or fascicled simple, rarely subspinescent; flowers solitary axillary subsessile. (*Temperate and Andine regions of South America, Peru, Chili, and southern Brazil.*) See p. 352.

11. **Cliffortia** L.—Flowers diœcious; receptacle of males minute subconvex; of females sacciform, ovoidal or tubular; mouth contracted. Sepals 3, 4, imbricated. Petals 0. Stamens ∞; filaments filiform free tortuous glabrous; anthers broadly-didymous introrse; in female flowers 0, or ∞, minute sterile tooth-like, inserted in mouth of receptacle. Carpels 2, or 1 (*Monographidium*); ovary included; styles slender exserted, apex stigmatose plumose; ovule 1, descending; micropyle superior extrorse. Achenes 2, or more frequently 1, included in leathery horny or subdrupaceous smooth or sulcate receptacle. Seed of *Sanguisorba.*—Shrubs, usually glabrous rigid; leaves alternate crowded, sessile or shortly petiolate, 1–3-foliolate; leaflets coriaceous parallel- or net-veined, rarely veinless, of very variable form; stipules membranous or spinose adnate to sheathing petiole; flowers axillary sessile, solitary or geminate. (*South Africa.*) See p. 353.

III. FRAGARIEÆ.

12. **Fragaria** T.—Flowers hermaphrodite or polygamo-diœcious; receptacle broadly pateriform, apex produced into an erect central cone. Calyx perigynous; sepals 5, free; præfloration finally valvate, slightly reduplicate, rarely subimbricate; leaves of calycle 5, exterior to and alternately with sepals. Petals 5, inserted around margin of disk lining receptacle, obovate slightly unguiculate; præfloration imbricate. Stamens ∞, usually 20, 3-seriate (of the *Rosaceæ*); filaments free, more or less persistent; anthers 2-rimose introrse. Carpels ∞, free, inserted on conical centre of receptacle; ovary 1-celled; style more or less ventral or subbasilar, apex obtuse or concave stigmatiferous. Ovule 1, incompletely anatropous descending; micropyle superior extrorse. Achenes or more frequently drupels ∞, inserted in depressed pits or on slightly prominent spaces on thick fleshy baccate ovoidal or globose receptacle, often finally deciduous; sarcocarp thin; putamen crustaceous 1-seeded; hilum lateral to membranous seed-coats; embryo fleshy; radicle superior.

Receptacle and leaves of calyx and calycle persisting round base of fruit.—Perennial herbs, usually stoloniferous, villous or silky, more rarely glabrous; subterranean stem (sympodium) thick woody; leaves alternate, trifoliolate, more rarely pinnate; stipules membranous adnate to sheathing base of petiole; flowers terminal or leaf-opposed, solitary or more frequently in a cyme terminating a common scape. (*Temperate and alpine regions all over Northern Hemisphere, mountains of South America and Mascarene Islands.*) See p. 355.

13. **Potentilla** T.—Flowers (of *Fragaria*) 4–5-merous. Stamens 20–∞ (of the *Rosaceæ*), more rarely 10 (*Horkelia*), or 5, opposite either sepals (*Sibbaldia, Ivesia*), or petals (*Chamærhodos*). Carpels ∞, (of *Fragaria*), rarely few or 1 (*Stellariopsis*); style often articulated at base terminal or ventral. Achenes (of *Fragaria*) inserted on finally dry or spongy receptacle. Other characters of *Fragaria.*—Herbs or undershrubs; leaves alternate, digitate or pinnate; stipules adnate to base of petiole. Flowers axillary or terminal, solitary or in corymbose cymes. (*All temperate and cold regions.*) See p. 357.

14. **Rubus** L.—Flowers hermaphrodite or polygamous; receptacle disk and perianth of *Fragaria;* calyx ecalyculate, imbricate or finally valvate. Stamens ∞ (of the *Rosaceæ*). Carpels ∞, more rarely few; ovary usually 2-ovulate; ovules collateral descending; micropyle superior extrorse; style subterminal. Drupes ∞, 1-seeded, inserted on dry or spongy conical receptacle; mesocarp rarely rather thin and hardly fleshy. Seed pendulous; embryo fleshy exalbuminous.—Shrubs, usually sarmentose, aculeate or glandular, rarely creeping herbs: leaves alternate, simple lobed or more rarely imparipinnate; stipules adnate to petiole; flowers rarely solitary, usually in axillary or terminal corymbose cymes. (*All temperate and warm countries.*) See p. 362.

15. **Geum.** L.—Flowers of *Fragaria;* calyx rarely ecalyculate (*Stylipus*). Carpels ∞, rarely few sub-definite (*Waldsteinia*), inserted on short or clavate, entire or plurifid receptacle; ovule 1, subbasilar ascending; micropyle inferior extrorse; style terminal or subterminal, often articulated at base (*Coluria, Waldsteinia*), straight or geniculate-inflexed, sometimes pilose (*Sieversia*). Achenes 1–∞, terminated by cicatrix of style, or straight or geniculate persistent

style itself. Seed erect; radicle of straight embryo inferior.—Herbs, often creeping or stoloniferous; rhizome perennial; radical leaves imparipinnate or pinnatisect; cauline few, often 3-foliolate or bract-like; stipules adnate to sheathing base of petiole; flowers solitary, or usually few cymoso-corymbose on erect scapes. (*All cold and temperate regions.*) See p. 365.

16. **Dryas** L.—Flowers hermaphrodite (of *Geum*), 8–9-merous. Achenes (of *Geum*) terminated by barbate plumose persistent styles. Radicle of embryo inferior.—Humble cæspitose undershrubs; stem short thick; leaves simple alternate; stipules adnate to petiole; flowers solitary terminal pedunculate. (*Alpine temperate and Arctic regions of Northern Hemisphere.*) See p. 367.

17. **Cowania** Don.—Flowers hermaphrodite or polygamous; receptacular glands sacciform or turbinate, glandular outside, lined by a glandular disk. Sepals 5, ecalyculate, inserted in throat of receptacle; præfloration imbricated. Petals 5, imbricated. Stamens ∞ (of the *Rosaceæ*), inserted in throat of receptacle. Carpels 5–∞ and achenes of *Dryas*. Seed ascending; albumen thin; radicle of straight fleshy embryo inferior.—Bushy shrubs; leaves alternate 3–5-fid or partite; stipules adnate to short petiole. (*California, Mexico.*) See p. 368.

18. **Fallugia** Endl. — Flowers hermaphrodite (of *Cowania*); receptacle hemispherical obconical; calyx 5-bracteolate; disk villous. Carpels ∞ and achenes of *Dryas*. Seed erect; embryo exalbuminous; radicle inferior.—A much-branched erect shrub; twigs virgate; leaves alternate irregularly 3–5-lobed or pinnatifid; stipules adnate to petiole; flowers solitary on long peduncles or few cymose. (*Mexico.*) See p. 368.

19. **Chamæbatia** Benth.—Flowers hermaphrodite (of *Cowania*); receptacle glandular outside, disciferous within; sepals imbricate ecalyculate; petals as many and stamens ∞ (of the *Rosaceæ*). Carpel 1, free inserted in bottom of receptacle; ovary 1-celled; style subterminal, deeply furrowed down one side; edges of furrow reflexed stigmatiferous; ovule 1, suberect; raphe ventral; micropyle inferior extrorse. Achene coriaceous included in persistent

receptacle. Seed suberect; hilum broad sessile; testa spongy; albumen scanty; radicle of erect embryo looking obliquely downwards.—A small glandular pubescent shrub; leaves 3-pinnatisect; lobules glandular at apex; stipules dentate, adnate to base of petiole; flowers cymose terminal. (*California.*) See p. 369.

20. **Purshia** DC.—Flowers of *Cowania;* receptacle infundibuliform, glandular without, disciferous within. Sepals 5, imbricate. Petals imbricate. Stamens 20–30 (of the *Rosaceæ*). Carpel 1 (of *Chamæbatia*). Fruit coriaceous, half immersed in receptacle. Seed suberect; albumen thin; embryo straight; radicle inferior.—A bushy shrub; leaves alternate crowded, 3-fid or pinnatifid; stipules adnate to petiole; flowers axillary and terminal, subsessile. (*Rocky Mountains.*) See p. 370.

21. **Cercocarpus** H. B. K.—Flowers apetalous; receptacle long and flask-shaped; neck linear very long and tubular, mouth broadly dilated into a short cupule. Sepals 5, free or connate at base; præfloration valvate. Stamens 15–20 or ∞ (of the *Rosaceæ*): filaments free incurved in bud, inserted around thin cup lining mouth of receptacle; anthers short, often pubescent, dehiscing by 2 introrse clefts. Carpel 1, free, inserted in bottom of receptacle; style terminal; ovary 1-celled; ovule 1, subbasilar ascending anatropous; micropyle inferior dorsal. Achene linear-oblong closely enwrapped by base of receptacle, and passing into a very long persistent plumose style carrying up with it the cupule and upper part of receptacular tube, cut off transversely in a circumcissile way. Seed linear erect; embryo fleshy exalbuminous; cotyledons linear superior; radicle short inferior.—Small trees or shrubs; leaves alternate simple petiolate; stipules 2, lateral, adnate to base of petiole; flowers solitary or more frequently very shortly spicate; axillary or terminal. (*Mexico, California.*) See p. 370.

22. **Coleogyne** Torr.—Flowers hermaphrodite; receptacle tubular, lined by a glandular disk. Sepals 4, 5, inserted in throat, imbricate. Petals 0. Stamens ∞ (of *Purshia*), inserted on both receptacle and an urceolate tube with ciliate rim produced above ovary. Carpel 1 (of *Purshia*); style inserted at middle of ventral angle of ovary; ovule 1, incompletely anatropous descend-

ing; micropyle superior extrorse. Fruit? . . . .—A shrub; branches crowded spreading, often spinescent in last ramifications; leaves alternate simple, crowded towards summit of twigs; flowers solitary terminal, bracteolate at base. (*California.*) See p. 372.

23. **Adenostoma** Hook. & Arn.—Flowers hermaphrodite; receptacle tubular or obconical 10-ribbed, lined by a glandular disk with its free edge thickened. Sepals 5, inserted in throat, imbricate. Petals 5, alternating imbricate. Stamens ∞ (7–20); filaments free (of the *Rosaceæ*); anthers introrse, dehiscing longitudinally; connective thickened. Carpel 1 (of *Purshia*); ovary at apex unequally gibbous pilose; style subterminal, geniculate, apex capitate stigmatiferous; ovules 1, 2, ventral descending; micropyle superior extrorse. Achene coriaceous, included in hardened receptacle. Seed? . . . .—Rigid shrubs; branches straight divaricating; leaves heath-like or fascicled entire; stipules minute lateral; flowers in multibracteate glomeruli, axillary to the leaves or the bracts of a compound spike. (*California.*) See p. 373.

IV. SPIREEÆ.

24. **Spiræa** T.—Flowers hermaphrodite or polygamous; receptacle concave, shortly campanulate or urceolate. Sepals 4–6, usually 5; præfloration imbricate or valvate. Petals as many, inserted in throat of receptacle, imbricated or contorted. Stamens 20–∞ (of the *Rosaceæ*); filaments free or connate at base, inserted in throat of receptacle either on 5–10-lobed margin or inner surface of glandular disk lining receptacle. Carpels usually 5, oppositipetalous or more rarely alternipetalous, more rarely 1–4 or more, free or connate to a variable height, inserted in bottom of receptacle; styles terminal or subterminal, straight or geniculate; apex truncate stigmatiferous; ovules 2–∞, 2-seriate inserted on ventral angle, transverse or descending, more rarely ascending. Fruit of 1–∞ achenes follicles or legumes, free or connate, straight or more rarely contorted. Seeds 1–∞, descending, usually linear thin; integuments membranous or marginate, subulate; embryo fleshy exalbuminous; radicle usually superior.—Shrubs or undershrubs, more rarely herbs; leaves alternate simple digitate pinnate or decompound; stipules lateral free or adnate to

sheathing base of petiole, often altogether absent. Flowers axillary or terminal in simple or cymiferous racemes corymbs or spikes; bracts often carried up; pedicels axillary inserted at a variable height. (*Temperate and cold regions of Northern Hemisphere, mountainous regions of tropics.*) See p. 374.

25. **Gillenia** Mœnch.—Flowers hermaphrodite; receptacle tubular 10-veined, lined by a thin disk. Sepals 5, imbricate, with glandular edges. Petals 5, elongated; præfloration contorted, more rarely imbricate. Stamens 10–20 (of the *Rosaceæ*); filaments short incurved inserted in tube; anthers 2-rimose introrse. Carpels 5, alternipetalous inserted in bottom of receptacle, free or slightly connate; ovary 1-celled; style terminal acute stigmatiferous at apex; ovules 2–12, ventral 2-seriate ascending; micropyle inferior extrorse. Follicles 1–5, coriaceous partly exserted from receptacle, 1–6-seeded. — Perennial herbs; rhizome rather thick; branches erect herbaceous; leaves 3-foliolate incised; stipules 2, small, or large and like the leaflets; flowers in lax terminal cymes. (*North America.*) See p. 377.

26. **Neillia** Don.—Flowers hermaphrodite; receptacle campanulate or turbinate, lined by a disk. Sepals 5, valvate or imbricate. Petals 5, imbricate. Stamens 10–∞ (of *Spiræa*). Carpels 1–5; ovary pluriovulate; ovules 2-seriate horizontal or some ascending or descending. Fruit of 1–5 membranous inflated follicles or legumes. Seeds 1–∞, some ascending, some descending. Albumen more or less thick, fleshy; embryo fleshy.—Bushy shrubs; leaves simple dentate or lobed; stipules large deciduous; flowers racemose or racemose-cymose. (*Temperate Northern and Eastern Asia, North America.*) See p. 379.

27. **Kerria** DC. — Flowers hermaphrodite; receptacle shortly cupuliform, lined by a pilose glandular disk. Sepals 5, imbricated. Petals 5 (of *Rosa*) alternate, contorted or imbricated. Stamens ∞ (of the *Rosaceæ*); filaments free slender; anthers dehiscing by 2 introrse clefts. Carpels 5, alternipetalous, or more free, inserted in bottom of receptacle; ovary 1-celled, apex truncate stigmatiferous; ovule 1, ventral descending; micropyle superior extrorse. Achenes; seed exalbuminous; embryo fleshy; radicle superior.—Shrubs;

branches virgate; buds scaly; leaves alternate simple petiolate; stipules lateral subulate caducous; flowers solitary terminal pedunculate. (*Japan, north of China?*). See p. 380.

28. **Rhodotypos** Sieb. & Zucc.—Flowers hermaphrodite; receptacle broadly infundibuliform, lined by a pilose glandular disk produced above into a depressed conical pitcher, silky within, 4-dentate at apex inclosing the carpels. Sepals 4, spreading imbricated; calycle of 4 alternating entire 2-fid or 2-partite leaves. Petals 4 (of *Kerria*), alternate imbricated. Stamens ∞ (of *Kerria*), inserted on receptacle below corolla, as well as on outer face of the pitcher. Carpels 4, inserted in bottom of receptacle and included in pitcher of disk, oppositipetalous; ovary 1-celled; style terminal, at apex scarcely capitate stigmatiferous; ovules 2, ventral collaterally descending incompletely anatropous: micropyle superior extrorse. Drupes 1–4, pisiform; mesocarp thin; putamen bony 1-seeded. Seed slightly albuminous; embryo fleshy; radicle superior.—A shrub; branches decussate; leaves opposite (of *Kerria*); stipules 2 lateral; flowers solitary terminal. (*Japan.*) See p. 381.

29. **Neviusia** A. Gray.—Flowers hermaphrodite; receptacle short cupuliform, lined by a glandular disk. Sepals 5, ecalyculate leafy serrate imbricate. Petals 0. Stamens ∞ (of *Kerria*). Carpels 2, 3, more frequently 4 (of *Kerria*); micropyle superior extrorse. Drupes 1–4, surrounded by enlarged calyx; mesocarp thin; endocarp fleshy; radicle superior inflexed.—A shrub; leaves alternate simple; stipules minute free lateral; flowers solitary or few terminal pseudumbellate. (*Alabama.*) See p. 382.

30. **Stephanandra** Sieb. & Zucc.—Flowers hermaphrodite (of *Spiræa*); receptacle broadly campanulate. Imbricate sepals and petals and disk of *Spiræa*. Stamens 10, inserted in throat of receptacle, 5 superposed to petals, 5 alternating. Carpel 1, inserted in bottom of receptacle; ovary 2-ovulate; ovules collaterally descending; micropyle superior extrorse, or one finally horizontal or descending; micropyle inferior introrse. Follicle 1, 2-seeded. Seeds albuminous; embryo fleshy superior.—A slender shrub; branches distichous flexuous; buds scaly; leaves alternate incised or pinnatifid; stipules lateral leafy persistent; flowers in simple or compound corymbose racemes. (*Japan.*) See p. 382.

V. QUILLAJEÆ.

31. **Quillaja** Mol.—Flowers diœcious or polygamous. Receptacle of hermaphrodite flower subconcave broadly cupuliform, lined by a thick fleshy stellate disk produced into 5 alternipetalous lobes, emarginate or 2-dentate, much adnate to sepals. Sepals 5, thick; præfloration valvate. Stamens 10, 5 larger alternipetalous inserted in apices of lobes of disk, 5 smaller between them; filaments free subulate; anthers introrse dehiscing by two clefts. Carpels 5, alternipetalous inserted on slightly prominent bottom of receptacle and cohering into a spuriously 5-celled ovary; styles 5, free terminal, at apex slightly dilated stigmatiferous; ovules ∞, ventral 2-seriate densely imbricated. Fruit of 5 stellately spreading legumes dehiscing in 2 longitudinal valves. Seeds ∞, compressed imbricated ascending with a long superior wing; embryo exalbuminous; cotyledons convolute; radicle inferior.—Evergreen trees; leaves alternate simple; stipules 2, lateral deciduous; flowers in axillary or terminal cymes; central flower of each usually hermaphrodite. (*Chili, Peru, South Brazil.*) See p. 383.

32. **Kageneckia** R. & Pav.—Flowers monœcious or diœcious; receptacle lined by a thin disk. Imbricate calyx and corolla of *Quillaja*. Stamens not more than 20 (of the *Rosaceæ*); anthers sterile in female flower. Carpels 5; ovaries inserted on slightly prominent bottom of receptacle; ovules ∞ (of *Quillaja*); styles ventral, inserted at a variable height, at apex obliquely dilated 2-fid stigmatiferous. Fruit of 5 stellately-spreading reflexed gibbous slipper-shaped follicles. Seeds ∞, imbricated ascending winged (of *Quillaja*).—Evergreen trees; leaves alternate coriaceous simple petiolate; stipules caducous; flowers terminal or axillary racemose or corymbose, females cymoso-racemose or solitary. (*Chili, Peru.*) See p. 385.

33. **Vauquelinia** Corr.—Flowers hermaphrodite; receptacle hemispherical, lined by a glandular disk. Sepals 5, valvate, and petals 5, imbricate of *Quillaja*. Carpels 5, alternipetalous; ovaries connate below into a 5-celled ovary; styles 5, at apex capitellate stigmatiferous; ovules 2, subbasilar collaterally ascending; micropyle inferior extrorse. Carpels girded by persistent base of receptacle and by calyx, finally coming apart; dehiscence loculicidal,

extensive. Seeds 1, 2, in each cell, erect winged exalbuminous (of *Quillaja*).—A tree; leaves alternate simple serrate, on long petioles; stipules minute; flowers terminal racemose-cymose. (*Mexico.*) See p. 386.

34. **Lindleya** H. B. K.—Flowers hermaphrodite; receptacle turbinate lined by a glandular disk. Sepals 5 and petals 5 alternate imbricated. Stamens up to 20 (of *Kageneckia*). Carpels alternipetalous 5, connate into a 5-celled ovary; cells 2-ovulate; ovules collaterally descending; micropyle superior extrorse obturated; styles 5; apex unequally dilated stigmatiferous. Capsule woody 5-celled loculicidal. Seeds descending compressed exalbuminous; embryo fleshy; radicle superior.—An evergreen tree; leaves alternate simple petiolate crenulate; stipules subulate; flowers terminal, solitary or more rarely few. (*Mexico.*) See p. 387.

35. **Exochorda** Lindl.—Flowers polygamo-diœcious; receptacle turbinate constricted more or less above the middle. Disk perianth and 15–20 stamens of *Lindleya*. Carpels in male flower 0 or minute, in female united into a 5-celled ovary; styles free; apex dilated stigmatiferous; ovules 2, descending obturated (of *Lindleya*). Capsule naked 5-celled; cells tapering, rather prominently winged at base, finally free, much compressed, splitting in two loculicidally, 1, 2-seeded. Seeds much compressed winged. Leaves alternate simple membranous exstipulate; flowers vernal, axillary or terminal, racemose; pedicels 2-bracteolate. (*North China.*) See p. 388.

36? **Pterostemon** Schauer.—Flowers hermaphrodite; receptacle turbinate. Sepals 5, valvate. Petals 5, finally reflexed; præfloration imbricated. Stamens 10, perigynous, 5 oppositipetalous linear, 5 alternipetalous, with dilated 3-toothed filaments; middle tooth antheriferous; anthers cuspidate, dehiscing by 2 introrse clefts. Ovary 5-celled adnate to base of receptacle; style 5-fid; apex truncate stigmatiferous; ovules 4–6 in each cell, ventral ascending. Fruit capsular 1–few-seeded, bearing persistent receptacle perianth and staminal filaments. Seed erect; embryo exalbuminous; radicle inferior.—A shrub, very branching dichotomous; leaves alternate petiolate simple coriaceous; stipules minute; flowers in small corymbose cymes. (*Mexico.*) See p. 389.

37. **Eucryphia** Cav.—Flowers hermaphrodite, usually 4-merous; receptacle convex. Sepals free; præfloration imbricated. Petals alternate, hypogynous, straight or oblique; præfloration imbricated or contorted. Stamens ∞, free hypogynous; anthers introrse 2-rimose. Ovary superior free 5–15-celled; styles 10–15, free, at apex tapering stigmatiferous; ovules ∞ in each cell, ventral 2-seriate descending. Capsule 5–15-celled, septicidal many-seeded; seeds descending compressed marginate or alate; albumen thin fleshy; embryo rather fleshy; radicle superior.—Resinous trees; leaves opposite coriaceous evergreen, simple or pinnate; stipules interpetiolar, minute or large; flowers axillary solitary pedunculate. (*Chili, Australia, Tasmania.*) See p. 389.

38. **Euphronia** Mart.—Flowers hermaphrodite; receptacle short urceolate; sepals 5, unequal, finally revolute. Petals? . . . . Stamens 5, perigynous; filaments either 4 connate in pairs and 5th free, or variably connate, unequal, cohering at broadly-dilated base into a ring of variable shortness, barbate below, finally free tapering; anthers? . . . . Germen free 3-celled; ovules solitary (?) pendulous in each cell; style filiform persistent, barbate half-way up, finally separable into 3. Fruit capsular, subcylindrical, with receptacle and calyx, persisting at base; mesocarp thin subsuberous 3-partible separating from endocarp; cells 3-gonous, also separating from slender central column. Seeds solitary pendulous in each cell, small ovoidal, at base produced into a long lanceolate wing; albumen scanty fleshy; embryo inverted, radicle short superior; cotyledons flat rather thick.—A tree (?); twigs alternate greyish-puberulous; leaves alternate simple quite entire, shortly petiolate; stipules? . . . .; flowers terminal racemose. (*North Brazil.*) See p. 391.

39? **Canotia** Torr.—"Calyx 5-fid small persistent. Petals? . . . . Stamens 5, hypogynous; filaments slender. Capsule long terete narrowly oblong, terminated by persistent style, 5-celled, septicidal 5-valvate; valves 2-fid at apex; epicarp thin fleshy; endocarp woody. Seeds solitary in each cell, compressed oblong suspended near apex of superior angle; testa coriaceous-chartaceous, produced below into a broad subfalcate wing; embryo large in axis of fleshy albumen; cotyledons broad flat; radicle short terete superior.—A

shrub or small tree, glabrous branching leafless; branches remote alternate terete striate rather thick, produced into elongated spines, marked with small distant brown scars; flowers subracemose at ends of twigs; pedicels spreading curved, articulated below middle." (*New Mexico.*) See p. 391.

VI. PYREÆ.

40. **Pyrus** T.—Flowers hermaphrodite, more rarely polygamous; receptacle urceolate, more rarely turbinate, lined by a disk swelling more or less above ovary, ending at a variable distance below stamens. Calyx 5-leaved; sepals imbricated in bud, then reflexed, either persistent or deciduous with apex of receptacle. Petals 5, shortly unguiculate; præfloration imbricated. Stamens 15–20, more rarely ∞ (of the *Rosaceæ*); filaments free, or shortly connate at base 1-adelphous; anthers dehiscing by 2 introrse clefts. Carpels 5, alternipetalous, or 2–4; ovaries obliquely inserted within receptacle, free on ventral margin, 1-celled; styles terminal, all free or more or less connate at base; apex truncate or capitate, stigmatiferous. Ovules 2 in each cell, collaterally ascending; micropyle inferior extrorse, often obturated. Fruit ovoidal globular or pyriform, drupaceous; mesocarp (receptacle) usually thick fleshy; endocarp 1–5-celled, crustaceous or cartilaginous; often 2-valvate. Seeds 1, 2 in each cell, erect; testa usually cartilaginous, slightly mucilaginous; embryo erect, radicle short inferior; cotyledons plano-convex fleshy.—Trees or shrubs; leaves deciduous alternate, simple or pinnate; stipules 2 lateral deciduous; flowers corymbose or cymose, often precocious, coming out from rather thick buds before the leaves. (*North temperate regions of both Worlds.*) See p. 392.

41. **Cydonia** T.—Flowers hermaphrodite (nearly of *Pyrus*); receptacle campanulate. Sepals 5, leafy. Petals orbicular, imbricated or rarely contorted in æstivation. Stamens 20–∞. Ovary adnate to receptacular cavity, incompletely 5-celled; cells cleft lengthwise internally, ∞-ovulate; ovules 2-seriate ascending; styles 5, free. Fruit pomaceous (of *Pyrus*) crowned by leafy calyx; endocarp cartilaginous; seeds ∞ in each incomplete cell; testa crustaceous, thickly mucilaginous outside.—Shrubs or small trees; leaves alternate (of *Pyrus*); stipules usually leafy; flowers solitary terminal or few corymbose. (*Central Europe, Central and Eastern Asia.*) See p. 395.

42. **Cratægus** T.—Flowers hermaphrodite; receptacle finally baccate, urceolate or campanulate. Sepals 5 (of *Pyrus*), persistent or caducous. Corolla and ∞ stamens of *Pyrus*. Ovary 1–5-celled adnate to bottom of receptacle; styles and ovules of *Pyrus*. Drupe ovate or globular; stones 5, free or coherent into one, putamen somewhat rarely (?) bony 2–5-celled. Seeds erect compressed exalbuminous.—Shrubs or small trees; twigs often spinescent; leaves alternate simple lobed or pinnatifid; stipules large or small, deciduous; flowers cymoso-corymbose bracteate terminal. (*Cold and temperate regions of Northern Hemisphere.*) See p. 396.

43. **Cotoneaster** Medik.—Flowers of *Cratægus;* stamens 10–∞. Carpels 2–5, free inside and at apex, adnate by back (or rather very oblique base) to inside of receptacle; cells rarely 2-partite by a spurious half-dissepiment (*Nagelia*); styles and ovules of *Pyrus*. Drupe of variable form, 2–5-stoned; stones bony 1-seeded. Shrubs or small trees, erect or decumbent; leaves alternate petiolate usually evergreen; stipules subulate deciduous; flowers solitary, or more frequently in terminal or axillary, often unilateral cymes. (*Northern and Central Asia, Northern Africa, Europe, North America.*) See p. 398.

44. **Eriobotrya** Lindl.—Flowers of *Cratægus*. Stamens not more than 20 (of the *Rosaceæ*). Ovary inferior, or rarely free at apex, 2–5-, more rarely 1-celled; styles free or more or less connate, at apex dilated or truncate stigmatiferous. Ovules (of *Pyrus*) often obturated. Drupe or berry 1–5-celled; cells 1–2-seeded; septa membranous or chartaceous, sometimes obsolescent. Seeds of *Cratægus*.—Trees or shrubs; leaves evergreen simple petiolate coriaceous; stipules small or large, subfoliaceous; flowers cymoso-racemose or corymbose terminal. (*Temperate Asia, California.*) See p. 399.

45. **Stranvæsia** Lindl.—Flowers of *Eriobotrya*. Ovary 5-celled half-superior; styles 5, connate at base, at apex 2-lobed stigmatiferous; ovules of *Pyrus*. Drupe of variable form; endocarp crustaceous 5-celled; cells dehiscing loculicidally and dorsally. Valves separating from each other, and from the axis, bearing median dissepiments. Seed exalbuminous; embryo fleshy; radicle inferior exserted.—A branching tree; leaves alternate evergreen petiolate

serrulate; stipules setaceous; flowers cymoso-corymbose, terminal and axillary. (*Mountainous and northern districts of India.*) See p. 400.

46. **Raphiolepis** Lindl.—Flowers of *Eriobotrya*; receptacle elongated tubular or infundibuliform, lined to a variable height by a glandular disk. Sepals and petals 5 each, imbricated, and stamens 20–∞ (of the *Rosaceæ*), all deciduous after anthesis with circumcissile upper part of receptacle. Carpels 2; ovary adnate to lower part of receptacular tube; styles 2 connate at base; ovules 2 in each cell (of *Pyrus*). Berry pulpy 1, 2-celled, 1, 2-seeded; seed erect turgid; embryo thick fleshy exalbuminous.—Trees or shrubs; leaves alternate simple evergreen; stipules 2, lateral subulate; flowers axillary or terminal, racemose or cymoso-racemose, bracteate. (*China, Japan, Sandwich Islands.*) See p. 400.

47? **Amelanchier** Medik.—Flowers of *Cratægus*; receptacle campanulate or urceolate. Stamens ∞. Ovary more or less adnate to receptacle, 2–5-celled; cells divided by incomplete spurious dissepiments; ovules (of *Pyrus*) solitary in each locellus. Berries spuriously 4–10-locellate; locelli 1-seeded; dissepiments and endocarp membranous or coriaceous; seed exalbuminous; testa thin; embryo fleshy.—Small trees or shrubs; leaves alternate simple deciduous; stipules elongated subulate or minute, more rarely 0; flowers racemose or cymoso-racemose, bracteate. (*North America, Asia Minor, Europe.*) See p. 401.

48. **Osteomeles** Lindl.—Flowers of *Cratægus*. Stamens 10–∞. Carpels 5, free or more or less united with each other and the receptacle; styles as many; ovules solitary in each cell, subbasilar or ascending. Drupes 5-stoned; stones bony or crustaceous, 1-seeded. Seed compressed; testa membranous; embryo exalbuminous fleshy. —Branching trees or shrubs; leaves alternate evergreen, simple (*Hesperomeles*) or more rarely imparipinnate; stipules minute; flowers cymoso-corymbose bracteate. (*Andine America, Sandwich Islands.*) See p. 402.

49. **Chamæmeles** Lindl.—Receptacle turbinate. Calyx and corolla of *Cratægus*. Stamens 10–20; filaments inflexed in bud subulate; anthers straight or oblong. Disk thin lining receptacle.

Germen 1, inserted in bottom and adnate to base of receptacle, free above, 1-celled; style terminal sulcate, at apex more or less capitate stigmatiferous. Ovules 2, collaterally ascending (of *Cratægus*); raphe ventral. Fruit drupaceous, crowned by calyx; style more or less persistent apical; putamen thick bony 1-seeded. Seed ascending; integuments membranous; embryo fleshy exalbuminous; cotyledons superior closely convolute.—Shrubs, glabrous or velvety; leaves alternate or subfasciculate, simple petiolate; stipules small deciduous; flowers racemose or corymbose axillary or terminal; pedicels bracteolate. (*Madeira, Mexico.*) See p. 402.

VII. PRUNEÆ.

50. **Prunus** T.—Flowers hermaphrodite; receptacle obconical tubular or urceolate lined by a glandular disk. Sepals 5 (more rarely 4, 6), inserted in throat of receptacle, deciduous; præfloration imbricated. Petals as many alternating deciduous, more rarely 0 (*Cerascidos*); præfloration imbricated. Stamens 10–20, more rarely ∞ (of the *Rosaceæ*). Carpel 1 (more rarely 2 or more), free inserted in bottom of receptacle; ovary 1-celled; style terminal, apex dilated stigmatiferous; ovules 2, collaterally descending; raphe ventral; micropyle superior extrorse thickly obturated. A drupe; epicarp membranous smooth (*Cerasus, Laurocerasus*), glaucous (*Prunophora*), or velvety (*Amygdalus, Persica*); mesocarp pulpy or hard (*Amygdalus*); putamen smooth, or rugose punctate (*Amygdalus, Persica*). Seed 1 (more rarely 2) descending; testa membranous; albumen thin or 0; embryo thick fleshy; radicle superior.—Trees or shrubs; leaves alternate simple; petiole often glandular; blade conduplicate or convolute in vernation; stipules 2, lateral; flowers solitary or more frequently corymbose or racemose, often coming out from scaly buds before or with the leaves. (*Northern and subtropical America, northern and temperate Europe.*) See p. 403.

51. **Pygeum** Gærtn.—Flowers hermaphrodite or polygamo-diœcious; receptacle concave (of *Prunus*). Sepals 5–15, tooth-like short. Petals as many or 0, small sepaloid. Stamens 10–20. Ovary sessile; style terminal, apex capitellate stigmatiferous; ovules 2, descending (of *Prunus*). Fruit dry or drupaceous, often transversely oblong, 1-seeded. Seed exalbuminous, transversely oblong; embryo

thick; radicle superior.—Trees or shrubs; leaves alternate simple persistent; stipules small deciduous; flowers racemose axillary or lateral. (*Tropical Asia, Malaysia, eastern tropical Asia.*) See p. 410.

52. **Maddenia** Hook. F. & Thoms.—Flowers polygamo-diœcious; receptacle and 10-merous calyx of *Pygeum*. Petals 5–10, linear confounded with calyx. Stamens 20–30 (of *Pygeum*). Carpels, of male flowers solitary tapering into a slender capitate style: of female flowers 2; ovary truncate apex crowned by an oblique sessile stigma; ovules 2, descending (of *Prunus*). Drupes 2, subcompressed glabrous; putamen crustaceous, 1-seeded, sometimes smooth sometimes 3-keeled. (*Temperate India.*) See p. 411.

53. **Prinsepia** Royle. — Flowers hermaphrodite; receptacle broadly cyathiform. Calyx 5-partite imbricated. Petals 5, shortly unguiculate, imbricated. Stamens 20–30 (of the *Rosaceæ*); filaments inflexed, inserted in throat of receptacle; anther-cells 2 discrete introrse rimose. Carpel 1, central; ovary shortly stipitate, 1-celled; style terminal, apex capitate stigmatiferous. Ovules 2, collaterally descending, micropyle dorsal superior obturated. Fruit oblique drupaceous anatropous, with persistent style and withered receptacle at base; putamen coriaceous 1-seeded. Seed ascending; embryo exalbuminous fleshy oily; cotyledons plano-convex; radicle inferior. — A branching shrub, twigs spinescent; leaves alternate simple serrulate deciduous; stipules 2, lateral minute; flowers axillary shortly racemose. (*Temperate India.*) See p. 411.

54? **Strephonema** Hook. F.—Flowers hermaphrodite, 4–5-merous; receptacle and perianth of *Prinsepia*. Stamens 8–10 (of *Prinsepia*), 5 alternipetalous, 5 oppositipetalous. Carpel 1, central; ovary partly inferior, at base adnate to receptacle; style terminal, at apex contracted stigmatiferous. Ovules 2, ventral collateral, amphitropous or descending; micropyle below umbilicus or slightly ascending; micropyle inferior. Fruit? . . . .—Trees, glabrous or silky-pilose, branching; leaves opposite and alternate, simple coriaceous; flowers axillary to leaves, corymbose or corymbose-subumbellate. (*West of tropical Africa.*) See p. 412.

55. **Nuttallia** Torr. & Gr. — Flowers polygamo-diœcious; re-

ceptacle subcampanulate lined by a glandular disk, deciduous. Sepals 5, imbricated. Petals 5, alternate, shortly clawed imbricated. Stamens up to 15 (of the *Rosaceæ*). Carpels 5, free. Ovary 1-celled gibbous; style short articulated, apex dilated stigmatiferous. Drupes 1–5, free; endocarp coriaceous 1-seeded. Seeds descending; testa membranous; embryo exalbuminous; radicle superior; cotyledons fleshy convolute.—A small tree, smelling of hydrocyanic acid; leaves alternate simple exstipulate deciduous; flowers racemose bracteolate, springing from scaly buds. (*North-west of America.*) See p. 413.

VIII. CHRYSOBALANEÆ.

56. **Chrysobalanus** L.—Flowers hermaphrodite; receptacle turbinate campanulate, lined by a thin disk. Sepals 5, imbricated. Petals 5, inserted with sepals in throat of receptacle, imbricated, deciduous. Stamens 15–20 (of the *Rosaceæ*); filaments free, connate at base, many often antherless; anthers dehiscing by 2 introrse clefts. Carpel 1, central, sessile in bottom of receptacle; ovary 1-celled, free; style basilar; apex capitate or truncate, stigmatiferous. Ovules 2, collateral sub-erect; micropyle inferior, looking towards insertion of style. Drupe more or less fleshy; putamen smooth or sulcate at base, indehiscent or 5–6-valved, 1-seeded. Seed sub-erect; embryo thick fleshy; radicle inferior very short.—Small trees or shrubs; leaves alternate simple, stipules small deciduous; flowers cymose axillary and terminal. (*Warm regions of America, tropical Africa. ?*) See p. 414.

57. **Licania** Aubl.—Flowers hermaphrodite (of *Chrysobalanus*); receptacle globose urceolate or hemispheric. Stamens 3–10, more rarely ∞ (of the *Rosaceæ*); filaments short, or rather long exserted (*Moquilea*), all fertile or on one side sterile antherless; anthers small, dehiscing by introrse clefts. Gynæceum central (of *Chrysobalanus*). Fruit of very variable form, globose ovate obovate pyriform or clavate, 1-seeded. Seed sub-erect, exalbuminous (of *Chrysobalanus*).—Trees or shrubs; leaves alternate simple, often glandular; stipules 2, persistent or deciduous, free or connate; flowers cymoso-racemose or spicate. (*Tropical and subtropical America.*) See p. 416.

58. **Lecostemon** Moç. & Sess.—Flowers hermaphrodite or poly-

gamous (of *Licania*); receptacle broadly cupuliform, lined by a glandular disk. Sepals 5, tooth-like imbricated deciduous. Petals 5, imbricated, inserted perigynously with calyx. Stamens ∞, perigynous; filaments very short, persistent; anthers elongated linear introrse rimose basifixed caducous. Gynæceum central (of *Chrysobalanus*); ovary 1-celled or spuriously sub-2-locellate, 2-ovulate; style basilar long tapering grooved longitudinally reflexed; edges of groove stigmatiferous. Drupe; mesocarp thin; putamen crustaceous 1-seeded. Seed reniform-globular; testa membranous; embryo exalbuminous; cotyledons thick conferruminate.—Glabrous shrubs; leaves alternate coriaceous; stipules minute or 0; flowers racemose or cymoso-racemose, terminal or axillary. (*Tropical and subtropical America.*) See p. 417.

59. **Stylobasium** Desf.—Flowers hermaphrodite or polygamous (of *Lecostemon*); receptacle campanulate; corolla and disk 0. Stamens 10, 2-seriate, 5 oppositipetalous, 5 alternipetalous; filaments hypogynous long filiform; anthers elongated exserted. Gynæceum central (of *Chrysobalanus*); ovary 1-celled, 2-ovulate; style curved slender, apex broadly peltate stigmatiferous. Drupe; mesocarp thin; putamen hard 1-seeded. Seed suberect; embryo slightly albuminous, transversely induplicate; cotyledons thick fleshy.—Small shrubs; leaves alternate simple coriaceous veinless; stipules minute or 0; flowers solitary axillary shortly pedunculate bracteolate. (*South-west Australia.*) See p. 418.

60. **Grangeria** Commers.—Flowers hermaphrodite; receptacle shortly turbinate more or less gibbous on one side. Perianth and 10–∞ stamens of *Chrysobalanus*; filaments all antheriferous or sterile on one side. Gynæceum (of *Chrysobalanus*) inserted unilaterally at a variable distance from bottom of receptacle. Drupe slightly fleshy; putamen angular 1-seeded. Seed exalbuminous.—Small trees; leaves alternate simple; stipules caducous; flowers axillary and terminal, racemose; racemes simple or compound. (*Mascarene Islands, Madagascar.*) See p. 419.

61. **Hirtella** L.—Flowers hermaphrodite; receptacle tubular more or less deeply gibbous or spurred on one side. Sepals 5 and petals 5, alternate, inserted in throat of receptacle, imbricated. Stamens 3–8

(rarely more), fertile unilateral, the rest antherless short glandular tooth-like, connate with base of fertile into a short ring around throat; fertile connate to a variable height, circinate in æstivation; anthers introrse rimose. Gynæceum (of *Chrysobalanus*) very excentric, inserted on one side of mouth of receptacle; ovary 1-celled, 2-ovulate; style slender elongated, circinate in æstivation. Berry or drupe 1-seeded; seed suberect; embryo exalbuminous; cotyledons thick plano-convex, or folded "one embracing the other" (*Thelira*).—Trees or shrubs; leaves alternate simple; stipules lateral often glandular; flowers racemose or cymoso-racemose; racemes simple or compound; bracts often glandular. (*Tropical and subtropical America, Madagascar.*) See p. 420.

62. **Couepia** Aubl.—Flowers hermaphrodite (of *Hirtella*). Petals 5 or 0. Stamens 15–∞, arranged in a complete or incomplete ring; filaments united to a variable height. Gynæceum of *Hirtella*. Drupe of very variable form; mesocarp fleshy or coriaceous; putamen woody 1-seeded. Seed of *Hirtella*.—Trees or shrubs; leaves alternate coriaceous; petiolate often 2-glandular at apex; stipules deciduous; flowers racemose or cymoso-racemose, axillary or terminal, bracteolate. (*Tropical and subtropical America.*) See p. 423.

63. **Parinari** Aubl.—Flowers hermaphrodite (of *Couepia*); receptacle slightly or deeply excavated on one side. Sepals 5, or more rarely 4. Stamens 10–∞, all fertile or some antherless, forming a complete ring or united into a one-sided bundle. Gynæceum of *Hirtella*; carpel 1, more rarely 2; ovary completely or incompletely 2-locellate, through a spurious dissepiment projecting to a variable extent between the two ovules. Drupe of variable form; mesocarp fleshy or fibrous; putamen bony, smooth or rugose, usually 2-celled; cells 1-seeded. Seeds exalbuminous.—Trees; leaves alternate persistent, with or without glands at base; stipules lateral; flowers cymoso-corymbose or racemose bracteolate. (*Tropical America and Africa, Madagascar, Indian Archipelago, northern Australia, Islands of the Pacific.*) See p. 424.

64? **Trichocarya** Miq.—"Receptacle hypocrateriform; tube cylindrical angular entirely adherent to swollen gynophore; sepals 5, 3-angular. Petals shorter than calyx ovate. Stamens 25 (?), forming

a complete ring ; filaments unequal connate at base, opposite to, larger but not longer than sepals ; anthers oblong. Ovary 1-celled ; ovules solitary? Drupe obovate-globose, constricted at base, shortly 3-quetrous ; putamen coriaceous, very thickly hirsute within. Seed erect, sulcate on ventral surface ; testa coriaceous.—Trees or shrubs ; leaves costinerved ; thyrsus racemiform ; flowers articulated with very short bracteate pedicel." (*Borneo, Sumatra.*) See p. 425.

65. **Acioa** Aubl.—Flowers hermaphrodite (of *Couepia*). Sepals and petals 5, imbricated. Stamens ∞ ; fertile 10–∞ ; filaments connate into a long narrow strap circinate in the bud, free at apex ; sterile stamens also 1-sided antherless, connate into a dentate crown simulating a disk. Gynæceum of *Couepia* ; ovary 2-ovulate ; style slender, circinate in æstivation. Drupe of very variable form ; mesocarp fleshy or coriaceous ; endocarp woody 1-seeded, usually pilose inside. Seed of *Couepia* ; cotyledons plano-convex fleshy or conferruminate.—Trees or shrubs erect or climbing ; leaves alternate simple coriaceous ; stipules deciduous ; flowers in axillary or terminal simple or compound racemes ; bracts usually glandular-dentate. (*Guiana, West of tropical Africa.*) See p. 425.

66. **Parastemon** A. DC.—Flowers polygamo-diœcious ; receptacle short, cyathiform or campanulate. Sepals 5, 6, imbricated. Stamens 2, fertile perigynous 1-sided ; filaments circinate in æstivation ; anthers introrse rimose. Gynæceum in male flower rudimentary, in female? . . . . Flowers coriaceous 1-celled 1-seeded. Seed erect ; testa thin pubescent ; embryo erect fleshy ; radicle inferior.—A shrub ; leaves alternate simple coriaceous persistent ; flowers racemose axillary and terminal. (*Malay Archipelago.*) See p. 426.

ADDITIONS AND CORRECTIONS.

Page 28 Note 1, add, as a synonym of *Consolida*: *Ceratosanthus*, SCHUR., *Enum. Pl. Transylv.*, 30.

" 37 Note 3, add: MASTERS, *Note on double flower of* R. Ficaria (*Journ. Bot.*, 1867, 158).—V. THIEGH., *Obs. sur la Ficaire* (*Ann. Sc. Nat. Sér.* 5, v. 88, t. 10).

" 42 Note 4, add: Of the last section SCHKUHR made the genus *Homalocarpus* (*Enum. Pl. Transylv.*, 3).

" 145 Note 1, add, as a synonym of *Kadsura* DC: *Panslowia* WIGHT.

" 207 Line 15 of notes, for *Rhodocarpus*, read *Rhopalocarpus*.

" 302 Note 1, add: *Fitzgeraldia* F. MUELL., *Fragm.* (edend)=*Unona*, Sect. *Canangium* (*Cananga* HOOK. & THOMS.)

For the *Ranunculaceæ* and *Dilleniaceæ* of Brazil and tropical Africa, add: EICHLER, *Mart. Fl. Bras.*, and OLIVER *Fl. of Trop. Africa*, i. 1–13.

INDEX OF GENERA AND SUB-GENERA

CONTAINED IN THIS VOLUME.

END OF VOL. I.